TRANSACTIONS

OF THE

ROYAL SOCIETY OF EDINBURGH.

VOL. XLVII.—PART III.—(No. 16).

with the compliments of the Author.

(24

THE ABORIGINES OF TASMANIA.

PART II.—THE SKELETON.

BY

PRINCIPAL SIR WILLIAM TURNER, K.C.B., F.R.S.

[WITH TWO PLATES.]

EDINBURGH:

PUBLISHED BY ROBERT GRANT & SON, 107 PRINCES STREET,
AND WILLIAMS & NORGATE, 14 HENRIETTA STREET, COVENT GARDEN, LONDON.

MDCCCCX.

Price Four Shillings and Twopence.

XVI.—The Aborigines of Tasmania. Part II. The Skeleton. By Principal Sir Wm. Turner, K.C.B., F.R.S., President of the Society. (Plates I., II.)

(Read December 20, 1909. Issued separately March 3, 1910.)

CONTENTS.

Introduction.

In a memoir "On the Craniology, Racial Affinities and Descent of the Aborigines of Tasmania," published by the Society in October 1908,* I described ten Tasmanian skulls in the Edinburgh Museums, and compared them with those of this extinct race in Paris, London, Oxford, Hobart Town and elsewhere. At that time I was under the impression that I had referred to all the crania of the aborigines, seventy-nine in number, which had been preserved in museums, and for the most part had been described. The memoir did not include a description of the rest of the skeleton.

Subsequent to its publication I have ascertained the existence of additional crania in other collections. In a valuable memoir by Professor Hermann Klaatsch "On the Skull of the Australian Aboriginal," published by the authority of the Government of New South Wales,† a female Tasmanian skull, No. 404 in the Sydney Museum, is frequently referred to and its characters are compared with those of Australian crania. During the summer, 1909, on the visit of Professor Louis Dollo, of the Royal Museum, Brussels, to deliver an address to this Society, I had the opportunity of showing him the collection of crania in the Anatomical Museum of the University, when he told me that the Brussels Museum contained the complete skeleton of a Tasmanian aboriginal, and a skull, said to be also from Tasmania, neither of which had been studied. With great courtesy he proposed to send the specimens to me to be examined and described. I wish most cordially to express my indebtedness to him for this great privilege. A note of particulars accompanied the specimens: "No. 310, male skeleton from Flinders Island, where a number

* *Trans. Roy. Soc. Edin.*, vol. xlvi. p. 365, part ii.

† *Reports of the Pathological Laboratory of the Lunacy Department*, vol. i. part iii., 1908, Sydney.

of the Tasmanian aborigines were interned; it was obtained in exchange.—MORTON ALLPORT, 1873." "No. 75*d*, a female skull purchased from the collection of Dr MEISSER, 1868." It is marked "Habitante, van Diemen."

In March of the present year a preliminary communication was made by Professor RICHARD J. A. BERRY and Dr A. W. D. ROBERTSON, both of the University of Melbourne, on a number of crania in public and private collections in Tasmania,* additional to those described by Messrs HARPER and CLARKE and referred to in my previous memoir. In a later communication † they reported that they had disinterred nine skeletons of Tasmanians in a burying-ground adjacent to Big Oyster Cove, where a settlement had been provided for the last remnant of the natives. They stated their intention to publish shortly a description of the interesting relics of this extinct race.

SKULL WITH SKELETON, NO. 310 (Plates I., II.).

Up to the present time only four complete, or almost complete, skeletons of the aborigines of Tasmania have been described. One, previously in the possession of BARNARD DAVIS, is now, along with two others, in the Museum of the Royal College of Surgeons of London; one, formerly belonging to the Anthropological Institute, is now in the Natural History Museum, South Kensington. A pelvis in one of the museums in Paris has been described by M. VERNEAU. ‡ I greatly esteem, therefore, the opportunity to examine the skeleton, No. 310, in the Royal Museum, Brussels, which Professor DOLLO has placed at my disposal for the purpose of description.

SKULL.—The skull was that of a male adult. It weighed, along with the lower jaw, 1 lb. 12½ oz. avoir. (800 grammes).

Norma verticalis.—The cranium was elongated, 174 mm. in maximum diameter, with prominent parietal eminences which contributed to its pentagonal outline. The frontal eminences were well marked. A convex mesial triangular area was mapped out on the frontal by a shallow depression on each side extending antero-posteriorly, the broad base of the area formed a bregmatic eminence; and the apex was between the frontal eminences. Each lateral depression, bounded below by the frontal part of the temporal curved line, passed backwards across the coronal suture on to the parietal bone, as far as the upper limit of the parietal eminence, which, together with the parietal part of the temporal curved line, bounded it below. The curved line intersected the parietal eminence near the middle. The sagittal suture was denticulated and its anterior third lay on the plane surface of the vault, but in its posterior two-thirds it was depressed in a groove, bounded on each side by a ridge in the bone, which formed the upper boundary of the antero-posterior parietal depression; the

* "Preliminary Communication on Fifty-three Tasmanian Crania, Forty-two of which are now recorded for the First Time," *Proc. Roy. Soc. Victoria*, xxii. (N.S.), part i., 1909.

† "Preliminary Account of the Discovery of Forty-two hitherto unrecorded Tasmanian Crania," *Anatomischer Anzeiger*, Bd. xxxv., No. 1, p. 11, August 10th, 1909.

‡ *Le Bassin dans les Sexes et dans les Races*, Paris, 1875.

groove widened as it passed backwards to the lambda. The vault sloped downwards from the lateral ridge to the parietal eminence, and had a roof-shaped form (fig. 1).

The side walls of the cranium below the parietal eminences did not bulge outwards, and the greatest transverse diameter, 131 mm., was in relation to them. The width diminished materially behind the eminences, and the asterionic diameter was 103 mm. The stephanic diameter was only 100 mm., and the zygomatic arches were clearly seen when looked at from the vertex, so that the skull was phænozygous. The parietal foramina were almost obliterated; the vault sloped gently downwards to the occipital squama in the post-parietal region, which was flattened from side to side, but had not

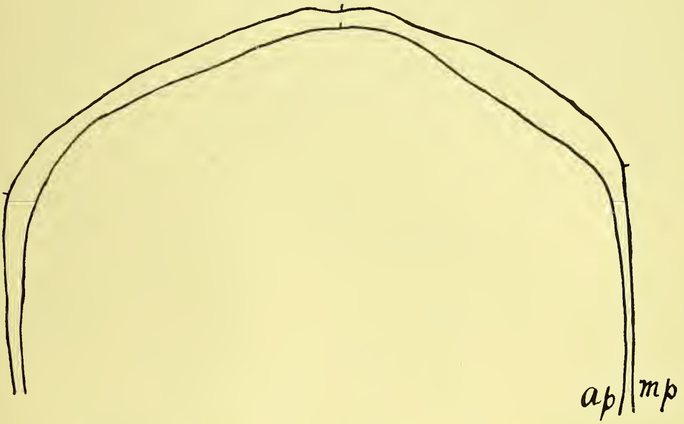

Fig. 1.—Vertical transverse arcs of skull in Brussels Museum, reduced a little. *ap.* immediately behind bregma; *mp.* in mid-parietal region.

been artificially produced. The supra-inial occipital squama bulged somewhat, the lambdo-inial curve was 60 mm. in vertical diameter, the inter-asterionic transverse curve was 140 mm. The inion was distinct: the *linea nuchæ superior* (torus occipitalis transversus) was strong for 25 mm. from the inion, and then became so feeble that the *processus retromastoideus** was only faintly indicated. The *linea nuchæ suprema* was not a continuous line, but consisted of small nodules. The crista occipitalis and linea nuchæ inferior were distinct. The surfaces of attachment for the semispinalis capitis, rectus minor, rectus major, and obliquus superior were clearly marked. As the lines and other marks on the occipital bone were much more distinct in No. 7 (Part I.) than in the Brussels specimen, I have reproduced a drawing of it

* I may refer to Professor Waldeyer's recent memoir, *Der processus retromastoideus*, etc., Berlin, 1909, for a most careful description and delineation of the nuchal and supra-mastoid regions, based on the study of the skulls of Papuans. I have in the text adopted his nomenclature.

in Pl. I. fig. 4. The posterior condyloid fossa was shallow and the foramen was small. A low ridge passed between the front of the occipital condyls. The pharyngeal tubercle was feeble.

Norma lateralis.—The lower part of the forehead slightly receded; the glabella and superciliary ridges were distinct, though not very protuberant; each ridge was separated from the supraorbital border by the supraorbital notch, and a continuous torus supraorbitalis was not produced. The supraorbital trigone was distinct between the superciliary ridges and the temporal curved line, and it sloped outwards to the thick external orbital process. The supraorbital depression was shallow and was not continued across the mid-frontal line. The nasion was distinctly depressed; the internasal suture was 18 mm. long; the greatest width of a nasal bone was 10 mm. at its free border; the profile outline of the nose was very concave; a low keel 3 mm. was present just below the nasion, otherwise the nasal bones were smooth and rounded from side to side. The frontal longitudinal arc was the longest, the occipital was the shortest. The mastoids were relatively feeble, and the skull rested behind on the cerebellar part of the occiput.

TABLE I.

Skulls, Royal Museum, Brussels.

Collection number,	Tasmanian, with Skeleton. No. 310	No. 75*d*
Age,	Ad.	Adol.
Sex,	M.	F.
Cubic capacity,	1080	1590
Glabello-occipital length,	174	173
Basi-bregmatic height,	123	140
Vertical Index,	*70·7*	*80·9*
Minimum frontal diameter,	92	93
Stephanic diameter,	100	113
Asterionic diameter,	103	108
Greatest parieto-squamous breadth,	131p.	147
Cephalic Index,	*75·3*	*85·0*
Horizontal circumference,	484	505
Frontal longitudinal arc,	124	120
Parietal ,, ,,	115	135
Occipital ,, ,,	110	120
Total ,, ,,	349	375
Vertical transverse arc,	276	319
Basal transverse diameter,	121	124
Vertical transverse circumference,	397	443
Length of foramen magnum,	31	33
Basi-nasial length,	96	97
Basi-alveolar length,	100	92
Gnathic Index	*104·2*	*94·8*
Total longitudinal circumference,	476	505

	Tasmanian, with Skeleton. No. 310	No. 75*d*
Interzygomatic breadth,	127	128
Intermalar ,,	112	113
Nasio-mental length,	104	116
Nasio-mental complete facial Index,	*81·8*	*90·6*
Nasio-alveolar length,	60	63
Maxillo-facial Index,	*47·2*	*49·2*
Nasal height,	46	50
Nasal width,	28	23
Nasal Index,	*60·9*	*46·0*
Orbital width,	36	37
Orbital height,	31	31
Orbital Index,	*86·1*	*83·8*
Palato-maxillary length,	58	47
Palato-maxillary breadth,	62	61
Palato-maxillary Index,	*106·9*	*129·7*
Nasio-malar Index,	*109·4*	*110·4*
Cranio-facial Index,	*73·*	*74·*
Lower jaw. Symphysial height,	25	33
Lower jaw. Coronoid ,,	55	60
Lower jaw. Condyloid ,,	54	64
Lower jaw. Gonio-symphysial length,	88	89
Lower jaw. Intergonial width,	93	91
Lower jaw. Breadth of ascending ramus	33	37

Norma facialis.—The floor of the nose was not separated from the incisive region by a sharp ridge, but was continuous with it by a smooth area; the maxillo-nasal spine was feeble, the anterior nares were wide, and the nasal index 60·9 was strongly platyrhine. The complete facial index was 81·8, the maxillo-facial index was 47·2; the index of both the complete face with the lower jaw, and of the upper face without it, was mesoprosopic, *i.e.* the face was moderately high in relation to the interzygomatic breadth. The gnathic index, computed by FLOWER's method, was 104·2; the incisive fossæ were shallow, and the eye recognised the prognathic character of the upper jaw. The canine fossæ were moderately deep. The nasio-malar index 109·4 expressed the mesopic or moderate nasal profile. The fronto-malar border of the orbit was thickened, the infraorbital suture was obliterated; the intraorbital width was 24 mm., the vertical diameter of the os planum was 12 mm.; the orbital index 86·1 was mesoseme, *i.e.* an orbit in which the width moderately exceeded the height. The hard palate was elongated, index 106·9, dolichuranic, moderately deep. The *torus palatinus medius* was a narrow mesial ridge on the horizontal plates of the palate bones, which expanded on the superior maxillæ into a broad elevated surface, which was separated from the alveolar border by a groove-like depression. The maxillo-premaxillary suture was either obliterated or showed a mere trace. The anterior palatine fossa, moderate in size, was triangular in shape, and the premaxillary part of the hard palate was short. The crista palatina transversa was not marked, but in Nos. 4, 5, 7 in Part I. it was strong. In the mandible the chin was feeble and only slightly projected in front of the alveolar border, the angle was incurved and somewhat obtuse, the ascending ramus and the marks for the masticatory muscles were moderate. The mental foramen was below the second præmolar tooth, and 24 mm. behind the symphysis. The inner surface of the bone at the symphysis had a genial prominence.

Teeth.—The teeth were all in place except the upper left middle incisor and wisdom, the sockets of which were empty, and the 1st lower right premolar, the socket of which was absorbed. They were regular in arrangement, and the crowns were flattened from use. The lower wisdoms had two buccal and two lingual cusps; the upper wisdoms had two buccal cusps, but the lingual were fused into a single large cusp. The sockets for the upper wisdoms were at the end of the maxillary tuberosity, in close relation to the pyramidal process of the palate bone. The diameters of the crowns of the premolars and molars were as follows:—

	UPPER.		LOWER.	
	Ant. Post.	Trans.	Ant. Post.	Trans.
1st premolar,	8 mm.	10 mm.	8 mm.	9 mm.
2nd ,,	8 ,,	11 ,,	7 ,,	9 ,,
1st molar,	11 ,,	12 ,,	11 ,,	11 ,,
2nd ,,	11 ,,	12 ,,	12 ,,	11 ,,
3rd ,,	8 ,,	11 ,,	10 ,,	10 ,,

The collective length of the molar and premolar series in the upper jaw was 46 mm., in the lower jaw 49 mm.; the length of the upper molar series was 32 mm., of the lower molar series 35 mm.; the width of the upper dentary arch opposite the 1st molars was 60 mm., opposite the 2nd molars 62 mm.; the corresponding diameters opposite the 1st and 2nd lower molars were 54 and 60 mm. respectively. The lower dentary arcade therefore fitted within the upper, and the crown of each lower molar and premolar passed somewhat in front of the corresponding upper tooth, so that the 1st lower premolar came in contact with the upper canine. A comparison of the antero-posterior and transverse diameters of the crowns of the upper molars and premolars with those given in my previous memoir on the Tasmanians showed that they closely corresponded in size. In this skull I computed a dental index, after the manner of FLOWER, by dividing the collective length of the upper premolars and molars by the basi-nasal length, and obtained the index 47·9. In the previous series these teeth were so frequently lost that the dental index could not be computed, but KNOWLES and FREIRE-MARRECO determined the index in the skulls in the Oxford Museum, which ranged from 40·8 to 53·1 with a mean 45·2. These measurements, therefore, confirm the statement of FLOWER * that the teeth of the Tasmanians are megadont. In a memoir on the dentary arcades in Australian aborigines, I gave data † to enable a comparison to be made between the teeth of the megadont Australian and the microdont European, and showed that in a number of Australians the upper and lower incisors were in apposition by their cutting edges, so that the lower did not fit within the upper when the mouth was closed.

The cranial sutures were not ossified; the denticles were generally simple, though more complex in the sagittal and lambdoid. In the right pterion the sphenoido-parietal articulation was only 6 mm. wide; two epipteric bones were in the left; two small Wormians in the lambdoid; no third condyl; jugal processes not tuberculated. The ali-sphenoid was deeply concave on the outer surface of its temporal division; at the spheno-temporal suture it was elevated into a ridge, immediately in front of which was a vertical groove; ‡ a similar but shorter ridge was also seen at the spheno-malar suture. The tympanic plate was completely ossified, the external meatus was narrow, the styloid was 7 mm. long.

The supra-mastoid crest curved upwards to the squamous suture and expanded into a *tuberculum supra-mastoideum anterius* (Waldeyer), behind which an indication of a *tuberculum supra-mastoideum posterius* was seen. In the male skulls in Part I. the crest and anterior tubercle were distinct, but the posterior was feeble or moderate in size. The zygoma was not strongly arched outwards; its upper border was sharp, the lower was relatively broad; the squamous end was smooth and concave on the inner

* *Journal of Anthropological Institute*, November 1884, p. 184.

† *Journal of Anatomy and Physiology*, vol. xxv. p. 461, 1891.

‡ A similar groove was noted by DUCKWORTH (*Journ. Anth. Inst.*, vol. xxxii. p. 177, 1902), and subsequently by KLAATSCH.

surface, the malar end was rough for the masseter; the glenoid fossa was shallow, and the eminentia articularis in the Brussels and the specimens previously described was flattened. The pterygo-spinous plate and foramen were absent, though present in No. 1 of the preceding series.* The foramen lacerum medium was moderate in calibre.

From the maximum length 174 and breadth 131 mm. the cranium had the cephalic index 75·3; it was therefore in the lower term of the mesaticephalic group approximating to the dolichocephalic. In the analysis of sixty-nine skulls given in Part I. of my memoir on Tasmanians, measured by previous observers and myself, the mean index was 74·7 on the confines between the mesaticephali and the dolichocephali. The Brussels skull, therefore, in this respect closely corresponded to the mean previously obtained.† The basi-bregmatic height was 123 mm., and the vertical or length-height index was 70·7, therefore less than the cephalic index. In sixty-five crania previously measured the mean vertical index was 71·1, also less than the cephalic index. The breadth-height index was 93·9. Both in this and the preceding specimens the skull was moderately high in relation to the length, and the index was metriocephalic. The cranio-facial index was 73, which closely corresponded to the mean 72·1 of six skulls described by me in Part I.

The cubic capacity, measured by the method I have employed for many years, was 1080 c.c., which is 20 c.c. less than the lowest capacity in the seven males recorded in Part I., the mean of which was 1235 c.c. In the strongly platyrhine nasal index, 60·9, it closely corresponded with the mean 59·9 of seven skulls described in Part I. The prognathous gnathic index 104·2 was comparable with two of these skulls, but was higher than the mesognathic mean 100·6 of that series. The upper face was moderately broad in relation to the height, and the maxillo-facial index, 47·2, was mesoprosopic like the mean 49 obtained in the same series. The nasal profile was moderately projecting, and the nasio-malar index 109·4 was, as in them, mesopic. The width of the orbital aperture was 5 mm. more than the height, and the index 86·1 was mesoseme, which differed from the mean microseme index 78·2 of the preceding series. The palato-maxillary index 106·9 was dolichuranic, and the length was relatively greater than the breadth compared with the mesuranic mean 113·4 of that series. As I have elsewhere pointed out, the palato-maxillary measurements, and consequently the index, are subject to a greater range of variation in the same race of people than is the case with the other measurements from which indices are computed,‡ though in the black races there are, without doubt, a much larger proportion of long dolichuranic palates than in Europeans.

The characteristic markings and the general aspect of the vault of the cranium in the fronto-parietal region; the fairly prominent glabella and superciliary ridges; the de-

* KLAATSCH saw a pterygo-spinous foramen in the Tasmanian skull in the Sydney Museum. Many years ago I stated its occasional occurrence in the skulls of Sandwich and Chatham Islanders.

† It should be stated, however, that in the nine specimens measured by me in Part I. the mean cephalic index was 72·7, therefore dolichocephalic.

‡ *Zool. Challenger Exp. Reports*, part xxix. p. 127, 1884.

pressed nasion; the projecting parietal eminences; the relations of length and breadth which place the skull on the confines between the mesaticephali and the dolichocephali, the height being less than the breadth; the platyrhine nose; the prognathic upper jaw; the marked phænozygous projection of the zygomata; the face moderately broad in relation to the height; the moderate degree of prominence of the nasal profile; and the small cranial capacity are features in which this skull corresponded with the Tasmanians previously examined, and from their importance when collectively present, in the determination of race characters, leave no doubt that this skull from the Brussels Museum is a good example of an aboriginal Tasmanian. We can proceed, therefore, with confidence to study the other bones of the skeleton, to enable us to determine if they also possess racial characters. In this connection it is interesting to note that the Brussels skeleton, the male No. 1761†, originally in the collection of BARNARD DAVIS, and the male and female skeletons in the Hunterian Museum of the Royal College of Surgeons of England, were also collected by Mr MORTON ALLPORT in 1872. Of these, two males were from a cemetery in Flinders Island where the natives were interned, and one, No. 1097, a woman who was moved from Flinders Island to Oyster Cove, d'Entrecasteaux Channel, where she died in 1867; possibly the other skeleton was also obtained by ALLPORT from the same island.

Hyoid.—This bone consisted of a body and a pair of great cornua. The posterior surface of the body was concave and smooth; the anterior surface was convex, rough, with a short spine projecting forwards from its middle. The body was 16 mm. wide and 9 mm. deep; each great cornu was 29 mm. long. The small cornua were not present.

SAGITTAL CONTOUR.

In Part I. of my memoir on Tasmanian skulls, I figured tracings obtained with LISSAUER's diagraph of the sagittal contour of six male skulls, and I gave a series of measurements of radii taken from the basion to definite points on the surface of each skull. These radii were bisected by a line drawn through the nasio-tentorial plane, so as to indicate the proportion of the cranial cavity occupied by the cerebrum, and that of the basal region in which the cerebellum, pons, and medulla are lodged. I selected the nasio-tentorial plane in preference to the glabello-inial plane, for it gave a more definite conception of the division of the cranial cavity into a cerebral and a non-cerebral space; also because the nasion is a more definite point on the surface of the skull than the glabella, which varies so much in form and degree of projection. I have made similar measurements of the skull of the Brussels skeleton, and I record them in Table II., alongside a column in which the mean measurements of six male Tasmanian skulls in Part I. are given:—

TABLE II.

Sagittal Contours.

	Brussels Museum.	Mean of Skulls in Part I.
Basi-inial radius, *b.i.*,	78 mm.	80 mm.
,, -occipital radius, *b.oc.*,	102 ,,	102 ,,
,, -lambdal ,, *b.l.*,	105 ,,	110·5 ,,
,, -perpendicular radius, *b.p.*,	122 ,,	131·8 ,,
,, -bregmatic ,, *b.br.*,	123 ,,	131·8 ,,
,, -glabellar ,, *b.gl.*,	99 ,,	127·1 ,,
,, -nasial ,, *b.n.*,	96 ,,	101·1 ,,
,, -alveolar ,, *b.al.*,	100 ,,	101·1 ,,
Nasio-tentorial plane, *n.t.*,	161 ,,	172 8 ,,
Tentorio-bregmatic segment,	91 ,,	91·8 ,,
,, -perpendicular ,,	92 ,,	93 ,,
,, -lambdal ,,	66 ,,	60·6 ,,
,, -occipital ,,	58 ,,	47·8 ,,
From perpendicular radius to point on arch of frontal above glabella,	96 ,,	94·1 ,,
From perpendicular radius to occipital point,	68 ,,	85·1 ,,
Collective heights of four diameters from tentorial plane to vault of cranium,	307 ,,	285·2 ,,
Total length and collective heights,	471 ,,	464·6 ,,
Parieto-squamous breadth,	131 ,,	132·6 ,,
Collective heights, length, breadth,	602 ,,	597·3 ,,

It will be seen that the basi-radial measurements in the Brussels skull were, as a rule, less than the mean radii of the former group, though the tentorio-lambdal and -occipital segments were appreciably longer in the Brussels skull; the collective heights, length and breadth in the latter were greater than in the former group.

In Table III. measurements are stated of the chords of the frontal and parietal arcs, and that of the occipital, from the lambda to the inion; for each arc a perpendicular has been erected from the chord to the highest point of the arc. A column has also been included which gives the mean of the corresponding measurements of six skulls in Part I.

TABLE III.

Chords and Arcs.

	Brussels Museum.	Mean of Skulls in Part I.
Nasio-bregmatic chord of frontal, *br.n.*,	104 mm.	108·6 mm.
Perpendicular therefrom to outer surface of bone,	26 ,,	24 ,,
Bregma-lambdal chord of parietal, *br.l.*,	103 ,,	113·6 ,,
Perpendicular therefrom to outer surface of bone,	18 ,,	24·1 ,,
Lambda-inial chord of occipital, *l.in.*,	57 ,,	56 ,,
Perpendicular therefrom to outer surface of bone,	6 ,,	7·1 ,,
Base line of skull,	127 ,,	134·5 ,,
Total longitudinal arc,	349 ,,	359 ,,
Longitudinal circumference,	476 ,,	495·1 ,,
Base line to total longitudinal arc,	2·7 ,,	2·63 ,,
,, ,, ,, circumference,	3·7 ,,	3·65 ,,
Cubic capacity of cranium,	1080 c.c.	1235 c.c.

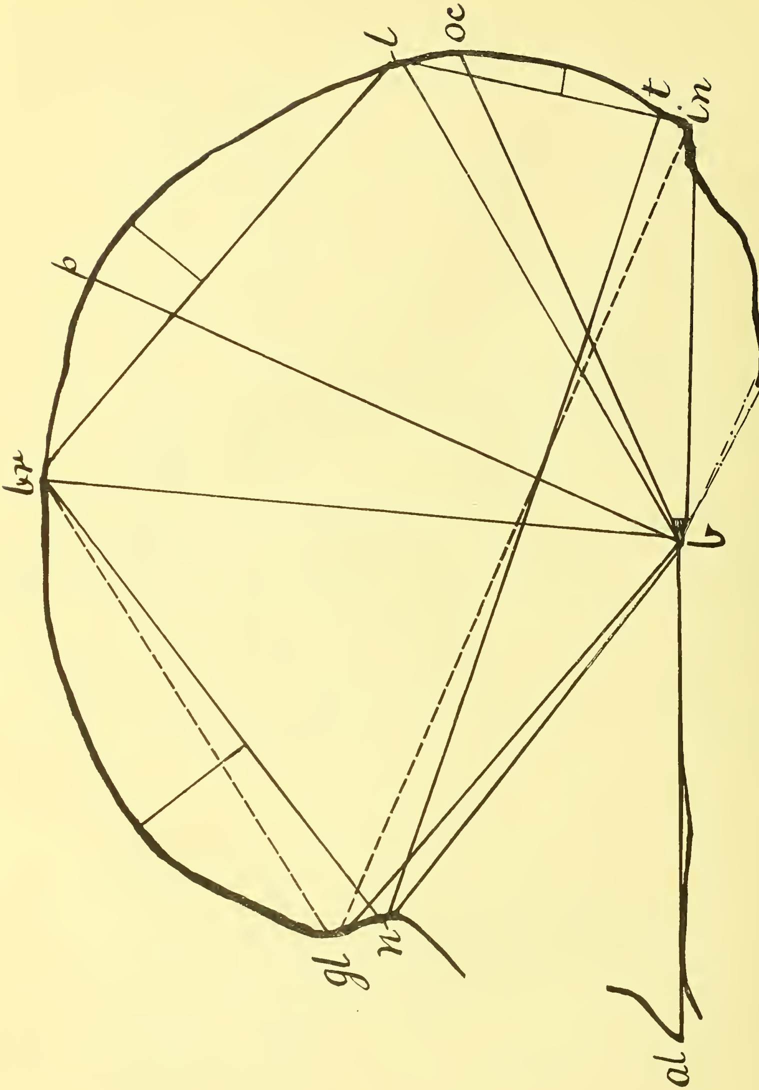

Fig. 2.—Sagittal mesial contour, Brussels skull, natural size. The broken lines are the glabello-bregmatic and glabello-inial diameters.

The chords of the frontal and parietal arcs in the Brussels skull were less than the mean of the corresponding chords of the Tasmanian skulls in Part I., but that of the occipital arc was 1 mm. longer. The vault of the frontal arc, 2 mm. more prominent than the mean, gave a well-arched forehead; that of the parietal was 6 mm. less prominent, and that of the occipital was 1 mm. less than the mean, and the projection of the occipital squama was less pronounced, though more so than in Nos. 5 and 6, in which the perpendicular line was only 3 and 4 mm. respectively.

In the same table I have stated the proportions which the base-line, as defined in Part I., bore to the total longitudinal arc and the longitudinal circumference, and I have given the mean of the series of Tasmanian skulls previously recorded in the same part. The base-line, the longitudinal arc, and the longitudinal circumference were smaller than the mean of the skulls previously measured, but the proportion of the arc and the circumference to the base-line was somewhat less (which corresponded with the smaller cubic capacity of the Brussels skull) than the mean of the skulls described in Part I. of my memoir on the crania of the Tasmanian aborigines.

Spinal Column, Ribs, Sternum and Pelvis.

The Vertebræ were smaller than one meets with in the Spines of European men. When the surfaces of the bodies were apposed the seven cervical were 74 mm. long, the twelve dorsal 206 mm., the five lumbar 120 mm.—in all, 400 mm. If to these be added the length of the sacrum 100 mm., and that of the coccyx 21 mm., the total length of the vertebral bodies, excluding the intervertebral discs but including the anterior arch of the atlas, was 521 mm. ($20\frac{1}{2}$ inches).

Cervical Vertebræ.—The spinous processes, except that of the axis, were not bifid; that of the 7th was most prominent, that of the 6th projected several mm. beyond the spines of the 5th, 4th, and 3rd; the posterior tubercle on the neural arch of the atlas was bifid. The grooves for the vertebral arteries on the atlas were not bridged by bone, although each was overhung by a projection backwards of the superior articular process. The vertebrarterial foramina were normal in the upper five vertebræ, but the 6th had the foramen on each side divided into two, and in the 7th the parapophysis was pierced by a small foramen in front of the normal hole. In the non-bifid character of the cervical spines this Tasmanian skeleton corresponded with other aboriginal skeletons, as pointed out by Owen, Hamy, Cunningham and myself in one of my *Challenger Reports*.*

Dorsal Vertebræ.—The 1st to the 9th had the customary two costal facets on each side of the body; the 10th, 11th, and 12th had only a single costal facet on each side.

* The references to the *Challenger Reports* in this section of the memoir are mostly to that on Human Skeletons, "Zoology, Chall. Exp.," part xlvii. p. 59, 1886. In this Report I suggested several new descriptive terms, which I have found to be of use in the study of the skeleton from the point of view of the anthropologist; these terms are employed in this section.

The transverse processes had costal facets for the corresponding rib tubercles as far as the 9th vertebræ ; in the lowest three the processes were non-articular and diminished in projection from the 10th to the 12th. Mammillary processes were present in the 11th and 12th. The dorsal spinous processes had no special variations in appearance.

Lumbar Vertebræ.—Both mammillary and accessory processes were present. The 1st lumbar transverse process was 10 mm. long, as compared with 19 mm., the length in the 3rd lumbar. The spines were normal. The 5th lumbar had no unusual modification.

In my *Challenger Report*, in addition to a description of the peculiarities observed in the spinal column, I dwelt at some length on the form and dimensions of the bodies of the lumbar vertebræ, and the part which they took in the production of the lumbar curve in the human spine. From the examination of a series of spines in Europeans, and in the aborigines who formed the special subject of that report, it was evident that the upper and lower surfaces of the lumbar bodies were not parallel to each other, but inclined obliquely, so that the body was wedge-shaped ; in the upper lumbar vertebræ the vertical diameter of each body was longer behind than in front ; in the lower it was longer in front than behind. These differences, and the part which they took in the production of the lumbar curve, were also investigated at the same time and independently on another series of racial skeletons by Professor D. J. CUNNINGHAM, and a numerical index was computed by each of us from the measurements of the vertical diameter in front and behind. If the upper and lower surfaces of the body were parallel and equal, the index would be 100, but if not parallel a *special index* for each vertebra could be obtained by the formula $\frac{\text{posterior vert. di.} \times 100}{\text{anterior vert. di.}}$, and a *general lumbar index* by dividing the collective posterior vert. di. × 100 by the collective anterior vertical diameters. If the resulting index was below 100 the anterior vertical diameter exceeded the posterior; if above 100 the posterior vertical diameter was the longer.

I have pursued this method in the Tasmanian skeleton now under consideration, and have computed the special and general indices in the four lower dorsals as well as in the lumbar vertebræ.

TABLE IV.

Tasmanian Spine.

	Ant. V.D.	Post. V.D.	Index.
9th dorsal vertebra,	19 mm.	18 mm.	94·9 Special Index.
10th ,,	21 ,,	20 ,,	95·2
11th ,,	21 ,,	21 ,,	100
12th ,,	22 ,,	23 ,,	104·5
	83 mm.	82 mm.	98·6 General Index.
1st lumbar vertebra,	24 mm.	25 mm.	104·1 Special Lumbar Index.
2nd ,,	23 ,,	25 ,,	108·7
3rd ,,	23 ,,	25 ,,	108·7
4th ,,	24 ,,	25 ,,	104·1
5th ,,	25 ,,	21 ,,	84
	119 mm.	121 mm.	101·6 General Lumbar Index.

It will be seen that in the 9th and 10th dorsals the anterior diameter exceeded the posterior, and the special index was less than 100; in the 11th they were equal; in the 12th the posterior exceeded the anterior, and the index was above 100. The general index 98·6 expressed that in the four lowest dorsals collectively the anterior vertical diameter was somewhat more than the posterior. In each of the upper four lumbar vertebræ, as in the last dorsal, the posterior vertical diameter was longer than the anterior, and the special index in each was more than 100; but in the 5th the anterior diameter, as is customary, was materially longer than the posterior, and the special index was only 84. The general lumbar index was 101·6, due to the collective posterior vertical diameters being somewhat longer than the anterior.

Professor CUNNINGHAM was the first anatomist to measure the vertical diameters of the lumbar bodies in the Tasmanian spine and to compute the indices. He examined three skeletons, two males and a female: Nos. 1096♂ and 1097♀ in the Museum of the Royal College of Surgeons of England, and No. 1761†♂ in the BARNARD DAVIS collection in the same museum.* He did not record the measurements of the individual vertebræ, but he stated the indices. In the upper four in both sexes the special index was more than 100: in the female the index was 107·8; the mean in the two males was 112·8. In the 5th lumbar the special index in both sexes was less than 100, and the mean of the three specimens was 92·4. The general lumbar index in the three skeletons computed by CUNNINGHAM was 107·2. In his specimens, as in mine,

* H. KLAATSCH subsequently recorded measurements of the lumbar vertebræ in these skeletons, as well as that in the Museum, South Kensington (*Zeitsch. für Ethnologie*, Heft 6, Tafel vii., 1903). His method was to take the height in the median plane of the body of the vertebra and to estimate the mean of the transverse breadth and to compute a breadth-height index from the formula $\frac{H \times 100}{B}$. The mean index of the three males was 52·4, that of the females 59·6. KLAATSCH'S measures differed both in method and purpose from those made by CUNNINGHAM and myself.

the general lumbar index showed that the posterior vertical diameters collectively were longer than the anterior, though in my example the difference in favour of the posterior was only 2 mm.; but it should be noted that the low index, 84, of the body of the 5th lumbar expressed for that vertebra a definite wedge shape, with the base of the wedge in front.

In my *Challenger Report* I discussed the question of the part taken by the lumbar bodies in the production of the lumbar curve in the human spine. I showed that in Europeans, whilst the 1st and 2nd vertebræ had the posterior vertical diameter longer than the anterior, in the 3rd, 4th, and 5th vertebræ the anterior diameter was the longer, the mean general lumbar index was 96, almost identical with the mean 95·8 obtained by CUNNINGHAM in measuring a larger number of European spines. In their lumbar region, therefore, it was obvious that the collective vertical diameter of the bodies was longer anteriorly than posteriorly, and that if their upper and lower surfaces were apposed to each other, without the interposition of discs, the lumbar curve was convex forwards. To this condition I gave the name *Kurtorachic.*

In my series of skeletons of the black races the collective vertical diameter behind was longer than in front, and the general lumbar index in the Australians was 106, in a Bushman 106, and in Sandwich Islanders 104. Both in the Australians and Sandwich Islanders, as in the Tasmanians, the upper four lumbars had the posterior vertical diameter greater than the anterior. In the Andaman Islanders and Negroes, however, the general index was 99, and in the 1st, 2nd, and 3rd lumbars only was the posterior vertical diameter greater than the anterior. CUNNINGHAM obtained similar results in Australians, Bushmen, Andaman Islanders, and Negroes, in which races the general lumbar index was, he stated, 104 and upwards. I found in my specimens, where the lumbar bodies were apposed to each other, without the interposition of discs, that the lumbar spine was concave forwards as low as the interval between the 4th and 5th lumbars, and to a spine in which this character was exhibited I gave the name *Koilorachic.* Tested in this way, the Tasmanian skeleton described in this memoir belonged to that group.*

In the study of the production of the lumbar curve in the complete spine the bodies of the vertebræ are not the only factors concerned, for the form and thickness of the intervertebral discs have to be considered. There can be no doubt that in Europeans the discs materially contribute to the production of the prominent lumbar convexity. This was proved many years ago by the brothers WEBER, who in their inquiry showed that the anterior surfaces of the discs, between the 12th dorsal and the 1st sacral, were collectively 21·1 mm. more in vertical diameter than the posterior, and that the disc between the 5th lumbar and 1st sacral took a special share, so that the

* As a sequel to the observations of CUNNINGHAM and myself on the relation of the vertical diameters of the bodies of the lumbar vertebræ to the lumbar curve, GEORGE A. DORSEY conducted a research on 85 skeletons of North American and Peruvian Indians (*Bulletin Essex Institute*, Salem, Mass., vol. xxvii., 1895). He obtained a mean general index, 100·9. In the 1st, 2nd, 3rd, and sometimes the 4th vertebra the posterior vertical diameter exceeded the anterior, but in the 5th lumbar the anterior was the longer. DORSEY places the Indian spines in the group which I named *Orthorachic*, where the index ranged from 98 to 102.

wedge-shaped discs contributed about three times more than the bodies to produce the forward convexity in the lumbar region. The influence exercised by the discs has been amply confirmed by subsequent anatomists.

Corresponding opportunities of determining the part taken by the discs in the black races generally have not as yet occurred; but Dr CUNNINGHAM * was able to study the curvature in the non-macerated spine of an aboriginal Australian girl aged 16. He stated that the lumbar convexity was very pronounced, and closely corresponded with that existing in European women: the curvature was due to the strong, wedge-shaped intervertebral discs. There can be no doubt that in other black races the lumbar region, with its bodies and discs, is convex forwards in the adult; and as the bodies themselves contribute little if anything to its production, the discs are the dominant factor in giving to the completed spine a kurtorachic character, as distinguished from the koilorachic curve formed when the surfaces of the bodies are directly apposed to each other.

Ribs.—The ribs were much more slender than in European men. They increased in length from the 1st to the 6th, and diminished from the 7th to the 12th. The 1st rib was 65 mm. in a straight line from the head to the sternal end, the 12th was 88 mm. The length of the 6th along the convexity was 274 mm. The 1st rib had a rudimentary scalene tubercle and a shallow subclavian groove; on its inner border and upper surface close to the sternal end was a raised smooth area for articulation apparently with the clavicle. The tubercles from the 1st to the 9th ribs were articular; they were absent from the 10th to the 12th.

Sternum.—This bone consisted of manubrium, body, and a rudimentary pointed xiphi-sternum. The length of the sternum was 117 mm., that of the manubrium 41 mm.; the broadest part of the manubrium was 50 mm., that of the body 45 mm. The surfaces of the bone were flattened. The manubrium was not fused with the body, but the xiphi-sternum was anchylosed to it. I have given examples in my *Challenger Report* from other aboriginal races of the xiphi-sternum preceding the manubrium in being fused with the body of the bone. The clavicular facets were distinct, the presternal notch was shallow. The lateral border of the manubrium had the customary facets for the 1st rib and half the second; that of the body articulated with 4 costal cartilages, with half the second and half the seventh, and the rest of the 7th cartilage was jointed to the xiphi-sternum.

Pelvis.—The pelvic bones were entire. The alæ of the ilium were expanded and the fossæ were translucent; the auricular surfaces were normal and the præauricular sulcus was present; the crest, with its spine and tubercle, was distinct. The pubic spines and symphysis were well formed; the pectineal lines and eminences were moderate. The ischial spines and tuberosities were well marked. The obturator foramen was elongated; the vertical diameter 48 mm. and the transverse 31 mm. gave an obturator index 64·6. The margin of the cotyloid cavity was well defined: the

* *Proc. Roy. Soc.*, London, vol. xlv. p. 301, Jan. 1889.

cotyloid notch was deep, narrow, 19 mm. in width; on the left side its ischial cornu was prolonged into a sharp process, which overhung the notch; it seemed as if the transverse ligament had been partially ossified; on the right side the cornu was not pointed but rounded. The antero-posterior diameter of the great sciatic notch was diminished by the projection into it of a sharp ridge, 16 mm. wide, which was prolonged from the ilium immediately below the posterior inferior spine.

Table V.

Measurements of Tasmanian Pelvis.

Breadth of pelvis,	246 mm.
Height ,,	185 ,,
Breadth-height Index,	*74·9* ,,
Between ant. sup. iliac spines,	228 ,,
,, post. ,, ,,	85 ,,
,, outer borders of ischial tubera,	138 ,,
Greatest diameter of cotyloid,	48 ,,
Vertical diameter of obturator foramen,	48 ,,
Transverse ,, ,, ,,	31 ,,
Obturator Index,	*64·6* ,,
Sub-pubic angle,	79° ,,
Transverse diameter of pelvic brim,	123 ,,
Conjugate ,, ,, ,,	95 ,,
Pelvic or Brim Index,	*77·2* ,,
Between inner borders of ischial tubera,	95 ,,
Depth of pubic symphysis,	36 ,,
,, pelvic cavity,	82 ,,
Length of sacrum in straight line,	100 ,,
Breadth of sacrum at base,	105 ,,
Sacral Index,	*105* ,,

When the bones were articulated the breadth of the pelvis at the tubercles on the iliac crests was 246 mm., and the height was 185 mm., which yielded a breadth-height index 74·9. Dr GARSON * computed the breadth-height index in four Tasmanian males as ranging from 77 to 84·6 mm., with a mean of 80. Both in breadth and height the Brussels pelvis was smaller than in male Europeans, in whom M. VERNEAU gave 27·9 mm. as the mean breadth and 220 mm. as the mean height in sixty-three pelves with a mean index 78·8. The mean breadth of six Australian males recorded in my *Challenger Report* was 252 mm., and the mean height was 194 mm., which resulted in a mean breadth-height index 77. Though in the Brussels specimen the index was below the Australian mean, when its index was conjoined with the indices of GARSON's male Tasmanians the mean was 78·6.

The transverse diameter of the pelvic brim, 123 mm., much exceeded the conjugate, 95 mm., the form of the inlet was transversely ovoid, and the brim index 77·2 was distinctly *platypellic*. In its form and relative dimensions the brim approximated to

* The references to Dr GARSON's measurements are to his chapter entitled "Osteology" in LING ROTH's important work on the aborigines of Tasmania.

the European male, in which a mean index at or near 80 has been computed by a number of observers, and the pelvis is consequently platypellic. In the Tasmanian male pelves previously measured by GARSON the mean index was 93·4 : they belonged therefore to the group which I have named *mesatipellic*, where the brim index ranged from 90 to 95. If the Brussels specimen be conjoined with these, the mean brim index would be 90·2, also mesatipellic. In the Australian pelves described in my *Challenger Report* I observed that the conjugate diameter was sometimes a little more, though at others somewhat less, than the transverse. In twenty-four specimens measured by myself and preceding anatomists the mean brim index 96·6 was distinctly dolichopellic (index 95 to 100), in which case the width of the brim rapidly diminished near the symphysis so as to produce a cuneiform inlet.

The subpubic angle was 79°, which was exceptionally wide for a male pelvis. In my *Challenger Report* I recorded in a powerful male Australian an angle of 70°, and in another an angle of 69°, in a Bushman 72°, in a Chinaman and a Malay 76° ; in these pelves the subpubic angle approximated more to that of the female than the male pelvis. From time to time, therefore, a male pelvis occurs in which the subpubic angle is not many degrees below the mean 85° found in the female, and is materially higher than the mean 64° obtained from measuring a number of male pelves. GARSON stated that the subpubic angle in four Tasmanian males ranged from 55° to 67°, with a mean of 61°, so that the Brussels specimen was exceptional for the race as well as for the sex.

Sacrum.—This bone consisted of five vertebræ fused together, and it had a gentle curve from base to apex. The spines were ossified ; that of the 5th was bifid ; the ossification of the laminæ was completed. The length in a straight line was 100 mm.; the greatest breadth of the base was 105 mm. The sacrum was *platyhieric*, the width exceeding the length, and the index was 105. In three male Tasmanians measured by GARSON the sacral index in one was 106·7, platyhieric; in two others 99, *i.e. dolichohieric.* When my specimen is included the mean of the four pelves was 102·4, *i.e.* platyhieric, owing to the higher index in one-half the number. In this respect the sacrum in the Tasmanians differed from the Australians, in which race the breadth of the bone seldom exceeded the length. The mean sacral index of six Australian males, measured by myself, was 98 ; and as the index was below 100°, they belonged to the group which I have named dolichohieric.

Coccyx.—This bone consisted of only three vertebræ. The first was not ossified either with the sacrum or the 2nd coccygeal, and it had the customary form. The 2nd and 3rd were fused together, and the 3rd was a nodule of bone no larger than a small pea. The length of the three vertebræ when articulated was 21 mm. ; the greatest breadth of the 1st vertebra was 33 mm.

Superior Extremity.

The bones were well proportioned, though their dimensions were much smaller than in the average male European.

Clavicle.—The clavicles were slender bones with the curves well marked, the muscular impressions feeble, the groove for the subclavius muscle shallow. About 14 mm. from the sternal end a raised smooth facet was on the under surface at the place of attachment of the costo-clavicular ligament, for articulation apparently with the surface on the 1st rib already described. The right clavicle was 132 mm., the left 131 mm. long in a straight line.

Scapula.—The spine, acromion, and coracoid, though relatively small, were normal. The suprascapular notch was deep and wide; the axillary border was scarcely falciform; the inferior spine was pointed; the coraco-scapular notch on the inner border of the glenoid was distinct. The right scapula was 141 mm. long from superior to inferior angle; 93 mm. broad from border of glenoid to vertebral border opposite the spine; in it the scapular index was 66, and in the left scapula the infraspinous length was 104 mm., and the corresponding index was 89·4. Garson gave 59 as the mean scapular index in the three Tasmanians which he measured, and the infraspinous index as 81·4. Klaatsch from his measurements of the London skeletons of Tasmanians obtained 60·7 as the mean scapular index. In my series of Australians the mean scapular index was 63 and the mean infraspinous index was 87. Broca gave 65·9, and Flower and Garson 65·2, as the mean scapular index in Europeans, and the same anatomists obtained respectively 87·7 and 89·4 as the infraspinous index. In the Brussels skeleton the scapular index was unusually high for the Tasmanians and approached the mean in Europeans.

Bones of the Shaft.—The long bones were relatively small and those of the forearm were slender. The *humerus* had well-defined ridges and processes; the deltoid impression and musculo-spiral groove were well marked. Neither supracondyloid process nor intercondyloid foramen was present. The *radius* and *ulna* had the articular surfaces distinct and the shafts were well formed; the interosseous interval was moderately wide. The length of the bones was as follows:—

	Right.	Left.
Humerus, maximum length, ...	289 mm.	279 mm.
Radius ,, ,, ...	231 ,,	228 ,,
Ulna ,, ,, ...	252 ,,	247 ,,

The bones of the right arm were therefore materially longer than those of the left. An antebrachial or *radio-humeral index* was computed for the right limb by the formula $\frac{\text{radial length} + 100}{\text{humeral length}}$. The index in this skeleton was 79·9. Topinard and Barnard Davis gave a mean index 79·6 as the result of their measurements of male Tasmanians, and Garson stated the mean as 79·9, which corresponded with my skeleton.

Many anatomists have measured the bones of the shaft in Europeans, and have obtained an index from 72·4 to 74·7, the mean being 73·4. In my series of Australians, again, the mean index in the males was 76·5, which closely corresponded with the results obtained by Topinard, Flower, and Spengel. In the Australians, and still more in the Tasmanians, the forearm is proportionally longer than the upper arm as compared with Europeans, and the index in the latter is almost the same as that obtained by myself and others in Negroes. The Tasmanians are, therefore, on the immediate confines of the group which I have designated in my *Challenger Report* long-forearmed, or *dolichokerkic*.

Hand.—The length of the skeleton of the hand from the lunare to the tip of the middle finger was 172 mm., the greatest breadth of the carpus was 43 mm., and at the head of the metacarpals of the four fingers 51 mm. The carpal bones were well formed; the metacarpals and phalanges were slender, and the carpo-metacarpal articular surfaces of the pollex and trapezium were saddle-shaped.

Inferior Extremity.

As the skeleton of the lower limb takes so important a part in the assumption of the erect and other attitudes of the body, the bones require to be examined more in detail than is necessary with the upper limb.

Bones of the Shaft.—The *femur* had strong ridges and trochanters. The shaft curved forwards; the anterior surface was convex, the internal was concave, the external was more deeply hollowed. The linea aspera had two well-defined lips with an intermediate narrow area. The middle third of the shaft, prismatic and triangular in section, was a good example of the *femur à pilastre*; opposite the nutrient foramen the antero-posterior diameter was 28 mm., and the transverse was 24 mm.; the pilastric index was 115, which expressed the strong projection of the linea aspera. The popliteal surface was faintly concave.

The head approximated to a sphere, but at the upper and outer part the articular surface extended beyond the outline of the head on to the anterior surface and upper border of the neck and formed an extensor area, which, during extension of the joint in the erect attitude, would have been in contact with the ilio-femoral ligament.* The anterior intertrochanteric line for the attachment of that ligament formed a broad rough ridge which indicated the strength of the ligamentous band so necessary for the preservation of the erect attitude. The neck of the femur was only 19 mm. long and 25 mm. broad. Below the intertrochanteric line the upper and anterior part of the shaft was expanded laterally and somewhat concave in front (Plate II. fig. 8).

Many years ago I recognised a similar expansion in prehistoric femora from a bone cave at Oban, as well as in some femora of aborigines, especially the Maoris.†

* See my address "On some distinctive characters of Human Structure" in *Reports of British Association*, Toronto meeting, 1897.

† See *Reports of British Association*, Edinburgh meeting, 1871, p. 160; also *Challenger Reports*, part xlvii. p. 97, 1886; also *Proc. Soc. Antiquaries*, May 1895, p. 415.

Manouvrier subsequently recognised the condition, and from the flattened form of the shaft named it platymery.* Associated with this character a prominent infratrochanteric ridge extended from below the great trochanter for from two to three inches vertically downwards and formed an external border for the upper third of the shaft: it was in front of and parallel to the gluteal ridge, from which it was separated by a narrow groove.

To enable a comparison to be drawn of the degree of expansion and flattening in different femora, Manouvrier computed an index of platymery by the formula $\frac{\text{antero-post diam.} \times 100.}{\text{transverse diam.}}$ In the Tasmanian skeletons the diameters and indices were

	Trans. diam.	Ant. post. diam.	Index.
Right femur . .	30 mm.	22 mm.	73·3
Left ,, . .	30 ,,	23 ,,	76·6

Manouvrier gave the platymeric index, in Parisian femora, as ranging from 80 to 100, whilst in some neolithic femora the range was from 56·4 to 65·8, and in Guanche femora from the Canary Islands from 58·8 to 64·9. In the two femora from the Oban bone cave the indices were 56·4 and 58·8. In the measurements of fifty Maori femora by Professor J. H. Scott of Dunedin, the index ranged from 54·8 to 81·3, with the mean 64·3.† In the Australian femora which I have examined, whilst the pilastric index ranged from 120 to 132 and the linea aspera was strong, in some specimens the upper fourth of the femoral shaft did not exhibit a marked degree of flattening, though Ramsay Smith found this condition in several aboriginal femora from the Coorong, and he gave 70·9 and 72·9 as the platymeric indices in two skeletons.‡ As far as can be judged from the single Tasmanian skeleton now before me, the index, whilst below the European, was higher than in neolithic and in the Maori femora.

The trochlear patellar surface was higher and broader on the outer than on the inner side; it was also deep, so as to accommodate the prominent vertical ridge of the patella in flexion and extension. The inner condyl was convex, more projecting, and somewhat narrower than the outer; a definite facet for articulation with the patella during complete flexion of the knee was distinct at the margin of the intercondylar notch. Each condyl had a sharp outline behind and was not prolonged upwards on to the popliteal surface of the bone. It did not present an extension of the articular surface similar to the one described by Sir Havelock Charles above the inner condyl in the natives of the Punjab, which he ascribed§ to pressure by the tibia due to the great flexion of the knee in the squatting attitude assumed by these people when resting.

* Manouvrier, *Congrès internat. d'Anthropol. et d'Archéol.*, 1889, 1891; and *Étude sur les variations du Fémur*, Paris, 1893.

† *Transactions New Zealand Institute*, vol. xxvi. p. 1, 1893.

‡ "The Place of the Australian Aboriginal in recent Anthropological Research," *Australian Association for Advancement of Science*, Adelaide, 1907. The Anatomical Museum of the University is indebted to Dr Ramsay Smith for a fine collection of the bones of the Australian aborigines. In a series from the northern territory the platymery is distinct and the infratrochanteric ridge is strongly marked.

§ *Journ. of Anat. and Phys.*, vol. xxviii. p. 10, 1894.

Patella.—The bone had the customary triangular compressed form, the vertical diameter was 39 mm., and the greatest transverse diameter was 37 mm. The vertical ridge, which divided its articular surface into two large areas, was broad and prominent and fitted between the femoral condyls in full flexion of the joint. The outer articular area was wider than the inner. The inner showed the internal perpendicular facet for adaptation to the area on the intercondylar border of the inner condyl in full flexion of the joint. The upper and lower pairs of transverse facets of GOODSIR,* though faintly marked, could be distinguished; the upper pair was apposed to the femoral condyls in

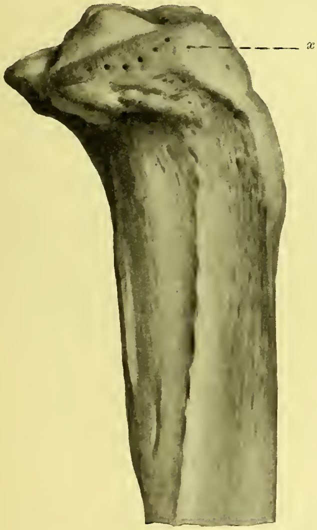

FIG. 3.—Upper end of right tibia.

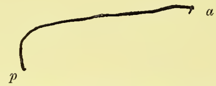

FIG. 4.—Tracing of external condylar surface, right tibia, Tasmanian; *a*, anterior, *p*, posterior.

full flexion, the lower pair to the upper border of the trochlea at the completion of extension of the knee.

Tibia.—The shaft was laterally compressed, the anterior border was strong and somewhat falciform; the internal subcutaneous surface was convex; the external was concave; the posterior was narrow and strongly convex in about the upper half, but flattened lower down. At the middle of the shaft the antero-posterior diameter was 33 mm., the transverse diameter was 21 mm., and the index obtained by the formula $\frac{\text{breadth} \times 100}{\text{ant. post. diam.}}$ was 63·6, which is somewhat less than the platyknemic index obtained by BROCA in the neolithic tibiæ from the French bone caves and that of 66 in the

* GOODSIR'S *Anatomical Memoirs*, edited by W. TURNER, "Anatomy of Knee-Joint," vol. ii. p. 225, Edinburgh, 1868

tibiæ of the Guanche people of the Canary Islands. The tibiæ, therefore, were distinctly platyknemic.

The axis of the head was not in the same vertical plane as that of the shaft, and the head was retroverted; its anterior surface formed with the anterior border of the shaft an angle of 29°. When the shaft was placed vertically the condylar articular surfaces sloped from before backwards and downwards; the internal was concave from before backwards and from side to side; the external was convex along the margin for the semilunar cartilage, and the area enclosed by the cartilage for apposition to the femoral condyl was partially flattened, partially faintly concave (figure 4). The external condylar surface formed with the front of the external tuberosity an angle of 80°; a deep depression behind for the attachment of the posterior crucial ligament gave a convexity to the condylar surface posteriorly. The modifications in the curvature of the external condylar surface and the retroversion of the head of the tibia in different races were carefully studied by Professor ARTHUR THOMSON some years ago.* He arranged tibiæ in five groups in accordance with the contour line of this condylar surface. The Brussels skeleton in this character resembled No. 2 in THOMSON'S figure, with which one Tasmanian skeleton, in the Museum of the Royal College of Surgeons, also corresponded; though in the two other skeletons of the same race the surface was, as in his group 3, more distinctly convex. THOMSON associated the form of the surface and the retroversion of the head of the tibia with the acutely flexed knee-joint in the squatting posture, a conclusion in which I concur. Some anthropologists have supposed that this configuration of the tibia indicated that the knee-joint could not, in those who possessed it, be fully extended, and consequently that the erect attitude could not be completely attained. Ample evidence, however, exists in the writings of those who saw living Tasmanians that they held themselves very erect when standing and walking.

A well-defined smooth area on the external tuberosity in front of the fibular articulation marked the attachment of the ilio-tibial band of the fascia lata (fig. 3, x).

The tibia had a special articular facet on the outer part of the anterior margin of the lower end which was 15 by 5 mm. in the right bone and 13 by 5 mm. in the left. It was continuous with the articular surface for the astragalus; on the inner part of which, close to the anterior border as well as on the articular surface of the malleolus, another facet was mapped out. The signification of these facets was recognised when the astragalus was articulated with the tibia, for the upper surface of its neck was not rough as in Europeans, but possessed two elongated smooth facets, separated from each other by a non-articular area, and prolonged forwards from the saddle-shaped surface of the astragalus almost to its anterior convexity. When the astragalus was moved on the tibia in flexion and extension the outer of the two elongated facets came in contact in acute dorsiflexion with the special facet at the outer part of the anterior border of the

* *Journ. of Anat. and Phys.*, vol. xxiii. p. 621, 1889; and the same, vol. xxiv. p. 210, 1890.

tibia, and the inner moved on the more internal tibial facet which was prolonged on to the internal malleolus.

The occurrence of similar special articular facets on the tibia and astragalus was first recognised by Professor ARTHUR THOMSON in the skeletons of Australians, Andaman Islanders, and some other aboriginal people; he associated their production with the pressure of the tibia on the astragalus when the ankle was acutely flexed in the squatting posture.* He also observed that the three Tasmanian skeletons in the Museum of the Royal College of Surgeons had inferior tibial facets and in two of these astragalar facets also. That the Tasmanians adopted, when resting, the squatting posture, is evident from the testimony of the early navigators.† The relation of the special tibial and astragalar facets to the squatting posture was also detailed by Sir HAVELOCK CHARLES ‡ in his memoir on the influence of pressure and posture in producing modifications in the skeleton of natives of the Punjab.

The malleolar groove on the back of the tibia for the tendons of the tibialis posticus and flexor longus hallucis was broad and deep.

Fibula.—The characteristic features of this bone were strongly marked, and a well-defined smooth area on the head, in front of the tibial articular surface, had attached to it the tendon of the biceps and the external lateral ligament.

Length of long Bones and relative Indices.—The dimensions of the bones of the shaft of the lower limb were as follows :—

	Right.	Left.
Femur, maximum length,	424 mm.	422 mm.
,, trochanteric-condylar length,	408 ,,	407 ,,
,, oblique maximum length,	421 ,,	419 ,,
Tibia, maximum length,	353 ,,	349 ,,
,, condylo-astragalar length, without spine,	350 ,,	346 ,,
Fibula, maximum length,	344 ,,	337 ,,

The corresponding long bones were not of equal length in the two limbs, and the right bones were somewhat longer than the left. In my *Challenger Report* I recorded a number of examples of inequalities in the length of the bones of the shaft in the same skeleton, and I referred to the previous measurements by Drs WIGHT and COX, and Dr GARSON. It is exceptional indeed to find the femora and tibiæ in opposite limbs equal in length, and the left bones are usually somewhat longer than the right, though the opposite was the case in the skeleton now under consideration.

In my previous memoir on the aborigines of Tasmania I stated the stature of the people as determined by measurements made during life, from which it appeared that it ranged in men from 5 ft. 1 in. to 5 ft. 6 or 7 in., with a mean of 5 ft. $3\frac{3}{4}$ in., and in women from 4 ft. 3 in. to 5 ft. 4 in., with the mean 4 ft. $11\frac{1}{4}$ in. Estimates have also been taken of the stature from measurements of the skeleton, and BARNARD

* *Opus cit.*, vol. xxiii. p. 616, and vol. xxiv. p. 210.
† See *Aborigines of Tasmania*, by H. LING ROTH, p. 13.
‡ *Journ. of Anat. and Phys.*, vol. xxviii. p. 1, 1894.

Davis and Flower have computed it as 5 ft. 3 to 4 in. If the stature be regarded as equal to twice the oblique length of the femur + the condylo-astragalar length of the tibia, with 26 mm. added as representing the thickness of the soft parts, the stature of this Tasmanian may have been 1572 mm., about 5 ft. $1\frac{1}{2}$ in.

Anthropologists have given attention to the relations between the length of the thigh and leg in the same person, and have expressed the same numerically by computing a *tibio-femoral* index as follows: $\frac{\text{tibial length} \times 100}{\text{femoral length}}$, the oblique length of the femur and the condylo-astragalar length of the tibia being the diameters employed. In the Tasmanian skeleton the index in the right limb was 83·1, that of the left 82·5. Topinard and Barnard Davis's measurements of three men gave a mean index 85, whilst Garson's figure was 84·1. In Europeans the mean index obtained by Topinard in men was 80·4 in one series of skeletons, and 81·1 in another. In the series of male Australians in my *Challenger Report* the index was 82·9. The index closely corresponded in the Tasmanians and Australians, in both of which the leg was longer in relation to the thigh than in Europeans, so that they are included in the group which I named *dolichoknemic* or long-legged.

The relative lengths of the femur and humerus or *femoro-humeral index* can be determined by the formula $\frac{\text{humeral length} \times 100}{\text{femoral length}}$. In the Tasmanian skeleton this index was 68·1; Garson gave 69·5 as the average in three males. In Europeans Broca obtained a mean 72·2 and Flower a mean 72·9. In my male Australians the mean was 71·4. Both in Tasmanians and Australians the index was lower, and the femur was therefore longer in relation to the length of the humerus than in Europeans.

I have also estimated the *intermembral index* by the formula employed by Broca, $\frac{\text{humerus} + \text{radius} \times 100}{\text{femur} + \text{tibia}}$, the bones of the shafts of the right limbs being selected. In this Tasmanian the index was 66·9, and Garson gave 68 as the mean in the specimens in the London museums. In Europeans Broca obtained a mean index 69·7 and Flower 69·2. In my male Australians the mean was 68·7. The Tasmanians and Australians gave a smaller index than the Europeans, and the lower limb was proportionally longer in the former than in the latter.

Foot.—The length of the skeleton of the foot from the heel to the tip of the great toe was 205 mm.: the breadth at the distal tarsalia was 52 mm., and at the heads of the metatarsals 63 mm. The special characters of the astragalus have been described in a preceding paragraph. The sustentaculum tali of the calcaneum formed a process 22 mm. in antero-posterior diameter, which projected inwards so strongly that along with the relatively large and projecting internal tuberosity of the bone the inner surface of the os calcis became deeply concave. The groove on the under surface of the sustentaculum for the flexor longus hallucis was broad and deep.

The tubercle of the scaphoid for the tibialis posticus was 18 mm. in antero-

posterior diameter, large and prominent. The cuboid had a slight articulation with the scaphoid, but it did not touch the astragalus, as KLAATSCH has stated to be the case in the Tasmanian skeletons in the Hunterian collection.

The tarso-metatarsal articular surfaces of the hallux and ento-cuneiform were each partially divided into two facets by marginal notches; they were concavo-convex in form, and permitted a greater range of active movement to the great toe than if the articulation had been plane surfaced.

It is interesting to note that the early navigators observed that the natives apparently unarmed, and with no weapons in their hands, trailed their spears after them on the ground as they walked, "the point being held between the great and second toes."* By a sudden rapid motion of the foot the spear could be transferred to the hand and effectively used as a weapon of attack.

The metatarsals and phalanges of the toes were relatively slender.

From the characters of the skeleton generally, without taking into consideration the special features of the skull, one would have no difficulty in pronouncing that it belonged to an aboriginal, black-skinned race, relatively small in stature. Thus the collective vertical diameter of the bodies of the lumbar vertebræ behind was longer than in front; the general lumbar index, as well as the special lumbar index of the upper four vertebræ, was more than 100. The vertebral bodies, from the 1st to the 4th inclusive, when directly articulated with each other, produced a curve concave and not convex forwards; in other words, a koilorachic spine. In the 5th lumbar, however, the body had a longer diameter in front than behind. In the black as in other races the intervertebral discs are important factors in producing the anterior lumbar convexity of the human spine.

In several of the black races the conjugate and transverse diameters of the pelvic inlet in males produced a brim index above 95, *i.e.* dolichopellic;† in two of the male Tasmanian pelves measured by GARSON the brim index was 99 and 98·2 respectively, therefore dolichopellic; but in the other two 88·6 and 88 respectively, therefore platypellic; whilst the mean index of the four pelves was 93·4, mesatipellic. The Brussels skeleton with its brim index 77·2 was therefore considerably below not only the mean index, but the lowest of the specimens previously measured, and in this respect was exceptional. In the relative length and breadth of the sacrum it also differed from the black races generally, in which the length exceeded the breadth and the sacral index was below 100, *i.e.* dolichohieric; for in this pelvis the breadth was greater than the length and the index was above 100, a proportion in which the sacral index corresponded with the mean 101·5 of three Tasmanian sacra measured by GARSON, 101·5, *i.e.* platyhieric.

In the Brussels skeleton, as in other black races, the forearm was proportionally longer than the upper arm as compared with Europeans; the limb was therefore

* LING ROTH, *op. cit.*, p. 14.

† See section on the pelvis in my *Challenger Report*, 1886.

dolichokerkic, and closely corresponded with the condition found in the few Tasmanians previously measured.

In the lower limb the femur had a degree of platymery, not so marked as in the Maoris and the femora of the cave men. The tibia showed marked platyknemia, and the head was retroverted, characters seen in many black races. The lower end of the tibia and the upper surface of the neck of the astragalus had prolongations of the articular surfaces, seen in those races which rest in the squatting attitude. In the relative lengths of the thigh and leg, of the femur and humerus, of the bones of the shaft of the upper compared with those of the lower limb, the Brussels skeleton corresponded generally with those of black races. There could be no doubt, therefore, that the skeleton in its collective characters was that of a man of a black race, and its association with the skull at once stamped it as a Tasmanian.

Skull No. 75*d*.

No. 75*d*, a female skull in the Royal Museum, Brussels, marked "Habitante, van Diemen," was also examined, and its measurements are recorded in Table I. It was not quite adult, for the basi-cranial joint was not fully closed and the wisdoms were only partially erupted.

Norma verticalis.—The cranium was not elongated, but was broad and rounded in outline. The glabello-occipital length was 173 mm., the maximum breadth was 147 mm. and the cephalic index was 85 mm. The skull was therefore definitely brachycephalic. The vault was smooth, rounded from side to side, and entirely devoid of the distinctive areas and depressions in the fronto-parietal region described in No. 310; the sagittal suture was not depressed; the parietal eminences were moderate; the parieto-occipital region sloped steeply downwards and was somewhat oblique, as if from artificial pressure. The occipital squama was flattened, the inion and curved lines were feeble The zygomata were cryptozygous.

Norma lateralis.—The frontal eminences were prominent; the lower forehead was almost vertical; the glabella and superciliary ridges were very feeble; the upper border of the orbit was sharp: a combination of characters which, in part at least, were without doubt sexual. The torus supraorbitalis was absent, and the supraorbital trigone was only feebly indicated. The nasion was not depressed. The nasal bones were keeled, projected forwards, and formed an obtuse angle of 74° with the lower frontal. The nose was therefore very prominent, and the nasio-malar index 110·4 was pro-opic. The parietal longitudinal arc was the longest, 135 mm., and the frontal and occipital arcs, 120 mm., were equal. The basi-bregmatic diameter, 140 mm., was less than the greatest breadth, and the vertical index 80·9 was less than the cephalic.

Norma facialis.—The maxillo-nasal spine was long and pointed; the floor of the nose was separated from the incisive region by a margo-infranasalis. The nasal region was long, relatively narrow, and leptorhine, the nasal index being 46; the complete

facial index was 90·6; the face was relatively narrow and long, owing in a measure to the depth of the symphysis menti, 33 mm. The upper jaw was orthognathic, index 94·8. The orbit was open, and the index 85·8 was mesoseme. The palate was short and relatively wide, and the index 129·7 was hyperbrachyuranic.

The lower jaw had a deep body and symphysis; the chin projected strongly forward; the angle was somewhat obtuse, and the ridges for the masticatory muscles were comparatively feeble. The teeth were not much worn. The cranial capacity, 1590 c.c., was remarkably high even for a woman of a European race.

When the characters above recorded are compared with those of the undoubted Tasmanian skull, No. 310, they will be seen to differ so essentially, that it is not possible to regard them as of the same race, although No. 75*d* may have been obtained in Tasmania. The absence of the characteristic marks on the vault of the cranium, the brachycephalic form and proportions, the very feeble glabella and superciliary ridges, the want of depression at the nasion, the extremely prominent nasals, the leptorhine nasal index, the orthognathic upper jaw, and the wide shallow palate, all point to very different racial affinities. There does not, indeed, seem to be any valid objection to regard this skull as that of a brachycephalic, orthognathic European, who might possibly at one time have lived in Tasmania; and the collector has labelled it as an inhabitant only of the island, and not necessarily the skull of one of the aborigines.

Comparison with the Skulls of Australians, Europeans, Palæolithic Man and Anthropoid Apes.

I have already referred to the important memoir by Professor Klaatsch,* in which he studied in the colonial museums the characters of the skulls of the aborigines of Australia, chiefly collected in Queensland, and gave a detailed comparative statement of their component parts. He discussed their variations and their possible evolution from some previously existing ancestral type. I wish to thank him for the frequent references which he has made to the chapter on the Australian crania and their variations in my *Challenger Report*,† and I am gratified to read that my descriptions very clearly demonstrated significant points and variations characteristic of the race, which accorded with his own observations. He also made frequent comparisons of the characters in Australian skulls with those in a female Tasmanian in the Sydney Museum, No. 404, and in some Tasmanians in museums in London and Paris which he had studied before he visited Australia.‡

In Part I. of my memoir on the Tasmanians I compared the characters of their skulls with those of Australians, Negritos, Papuans and Melanesians. In view, however, of the more detailed criticism which Klaatsch has given on the Australian skull, I propose to compare my series of Tasmanians with the Australians in regard to the char-

* *Op. cit.*, 1908. † *Zool. Chall. Exp.*, part xxix., 1884. ‡ *Zeitsch. für Ethnol.*, 1903.

acters which he has especially emphasised; but I recognise that the points of correspondence and difference cannot be regarded as altogether determined until a larger number of skulls has been minutely studied.

In Part I., whilst allowing for variations in individuals of both races, I pointed out easily recognisable differential features: the elongated ovoid cranium with its roof-shaped vault; the marked dolichocephalic proportion due to its greater length and smaller breadth, the height being usually more than the breadth; the stronger glabella, superciliary ridges and supra-orbital borders; the more receding forehead; the more prognathic upper jaw; the feeble maxillo-nasal spine; the longer and narrower hard palate, and the stronger lower jaw and chin possessed by the Australians in comparison with the Tasmanians. On the other hand, the Australians did not exhibit in similar degree the characteristic markings on the fronto-parietal vault, the prominent parietal eminences and the frequent pentagonal outline of the Tasmanians. In both peoples the skulls were phœnozygous, platyrhine, usually microseme, and normally of small cranial capacity. Other features of difference and resemblance will now be detailed.

Supra-orbital Region.—In his account of the Australian skulls and their correspondence in certain characters with the anthropoid apes and palæolithic man, KLAATSCH discussed the supra-orbital region and its modifications in ancient and in the modern human types. He referred to SCHWALBE's observations on the torus supra-orbitalis, formed by the fusion of the pars (arcus) supra-orbitalis and the pars (arcus) super-ciliaris, and to the opinion which SCHWALBE expressed that its presence in the Neanderthal and other examples of palæolithic man constituted a character which distinguished ancient man and the anthropoids from modern man. Whilst KLAATSCH recognised that in the Australians generally the super-ciliaries and supra-orbitals were not continuous with each other, he cited an Australian skull, R. 62, of the Kalkadun tribe,* N.W. Central Queensland, in which the torus resembled that found in anthropoids, Pithecanthropus and the Neanderthal skull. Though he regarded this specimen as absolutely unique in a modern human skull, he considered it sufficient to show that there is not such a fundamental difference between the Neanderthal type and the Australian aborigines as SCHWALBE had stated. The exceptional formation in the Kalkadun skull is not, however, so rare as KLAATSCH supposed. In a memoir "On the Evolution of the Eyebrow Region of the Forehead," † Professor CUNNINGHAM described and figured two Australian skulls in the Anatomical Museum ‡ of the University of Edinburgh in which a massive, projecting torus supra-orbitalis extended from the glabella to the fronto-malar suture, similar in appearance and construction to that present in the Neanderthal and Spy crania. I may also refer to my description of a Tasmanian skull, No. 6 in the first part of my memoir on this race, in which I stated that the superciliary ridge was directly

* See KLAATSCH's figure 59.

† *Trans. Roy. Soc. Edin.*, vol. xlvi., part ii., p. 283, 1908.

‡ B. 1, from New South Wales; A. 10, from Queensland.

continuous with the supra-orbital border as a torus supra-orbitalis * (see Plate II. fig. 5). These additional examples strengthen the statement by KLAATSCH that the presence of a torus supra-orbitalis in the Neanderthal type did not constitute a fundamental difference between it and modern man. In regard to the flattened condition of the frontal bone between the supra-orbital border, external orbital process and the temporal ridge, named by SCHWALBE the *trigonum supra-orbitale*, I described the character many years ago in the skulls of several Australian aborigines, and I stated that in this respect and in the prominent glabella and superciliary ridges they approximated to the Neanderthal cranium.† Since then I have pointed out this character in the Tasmanian skulls described in Part I. of this memoir.

The thickness and projection of the torus supra-orbitalis in anthropoid apes would lead one to think that in them the height of the orbit would be diminished in correlation with the thickness of the torus. On the contrary, in the anthropoids the orbital aperture has a relatively high vertical diameter, a rounded outline, and therefore a high megaseme orbital index.

In order to give numerical expression to the character of the orbit in anthropoid skulls, I have measured the width and height of the aperture in the specimens in the University Museum and have computed the orbital index as in the human cranium. The collection contains the skulls of seven gorillas, five adult males, one adult female and a young specimen. In each adult the orbital width was somewhat greater than the height, the index ranged from 76·5 to 95·4 and the mean was 88·6. In the young gorilla the height 40 mm. was greater than the width 35 mm., and the orbital index was 114·3. In two adult chimpanzees the mean index was 94·2, and in two young skulls with the milk dentition it was 96·5. In four adult orangs the height was materially greater than the width, the orbital index ranged from 108·1 to 122·5 and the mean was 114·4; in two young skulls the mean was 106. In the skulls of five gibbons (Hylobates) the index ranged from 87·5 to 104·1 and the mean was 93·9.

In the Australians, again, a large proportion of the male skulls had prominent glabella, superciliary and supraorbital ridges, and in all the specimens which I have measured the width of the orbit invariably exceeded the height. In twenty males the orbital index in eleven was below 80, five of which were below 75, and the mean index 81·4 was microseme; the mean of nine women was 90, megaseme; in four young skulls the mean was 83·5, microseme.

In the nine Tasmanian skulls which I have measured, the orbital index ranged from 68·2 to 86·1, and the mean index was 79, *i.e.* microseme.

In illustration of the two diameters of the orbit in Europeans, I may take the dimensions obtained in my study of the Craniology of the people of Scotland.‡ I measured 125 skulls, 84 men and 41 women. In two skulls the height exceeded

* I did not give a figure of the eyebrow region of this skull in Part I., but fig. 5 in Plate II. of this Part shows the character of the region.

† *Challenger Report*, part xxix. p. 31, 1884.

‡ *Trans. Roy. Soc. Edin.*, vol. xl., part iii., p. 547, 1903.

the breadth, and the index was 102·6 and 102·8 respectively. In one skull these dimensions were equal, but in 122 skulls the width exceeded the height, though in several specimens by not more than 1, 2, or 3 mm. In fifty-seven skulls the index was above 89, or megaseme; in thirty-three skulls it was below 84, or microseme; in the remaining thirty-three it was between 84 and 89, *i.e.* mesoseme. In a considerable proportion of the Scottish skulls the aperture of the orbit was high in relation to the width and was somewhat rounded in outline.

In the dimensions of the orbit the European, with the comparatively rounded outline of the aperture, more closely approximated to the anthropoid character than did the Australian and Tasmanian; though these races in the form and projection of the supra-orbital region were more allied to the gorilla, chimpanzee and palæolithic man than was the European. It seems, therefore, as if the strong supra-orbital development did not produce so great an effect on the vertical diameter of the orbit as might at first seem to have been likely, though it should be kept in mind that the orang with its high orbital index does not have the supra-orbital region so strongly developed as in the gorilla and chimpanzee.

Nasal Region.—A frequent character in the skulls of male Australians was a deep depression at the nasion, due to the projection of the glabella and the recession of the fronto-nasal suture. In the male Tasmanians a similar appearance was present, though usually not so strongly marked as in the Australians. The Neanderthal and Spy crania showed even more pronounced examples of this character. In Europeans, again, a strongly depressed nasion was quite exceptional, and could not be regarded as a race character. Neither the gorilla nor the orang had a depressed nasion, and the glabella joined the root of the nose by a very gentle curve; in the chimpanzee the curve was more abrupt, though without the formation of an acute nasion depression. In this feature, therefore, the Australian, the Tasmanian and palæolithic man differed more widely from the anthropoids than is the case with the European.

The form and articulations of the nasal bones also require to be considered. In the adult gorilla and chimpanzee, owing to the early obliteration of the facial sutures, it was difficult to state precisely the position of the fronto-nasal suture, and to measure the length of the nasal bones. In young animals, however, these points could be ascertained. In two chimpanzees, in the stage of the milk dentition, the nasals were fused together in each skull, and the conjoined bones were 20 and 14 mm. long respectively. They ascended between the internal orbital processes of the frontal to the glabella, and were as if wedged in between the ascending processes of the superior maxillæ. They were only 3 mm. wide at the constriction in the middle of their length, but widened to 7 mm. near the tip. In an orang at almost the same stage of dentition, as well as in an older specimen in which the milk canines had not been shed, the nasals were fused and narrow, and were 22 and 23 mm. long respectively. In the adults the nasals were 30, 33 and 37 mm. long respectively, and seemed to penetrate the substance of the glabella, in which they tapered to a point. In the

constricted part at the middle they were 4 mm. wide and expanded to 7 mm. near the free end. The surface was flattened, had no trace of a keel, and approximated in direction to the plane of the forehead.

In the young gorilla the nasals, partially fused, were 47 mm. long and only 3 mm. wide at the constricted middle part, but expanded to 8 mm. near the fronto-nasal suture, and to 17 mm. near the free end, where the mesial part of the right nasal formed a separate ossicle (Pl. II. fig. 7). In the adults the nasals varied in approximate length from 45 to 56 mm.; they were fused in the middle line and marked by a distinct keel in the upper two-thirds, which faded away towards the free end. In two only of the gibbons (Hylobates) could a fronto-nasal suture be seen, and in them the nasals were 6 and 9 mm. long respectively. Both the adults and the young had short, flattened nasal bones, fused together and destitute of a mesial keel.

The nasals in the large anthropoids were characterised by their length and slender form as compared with man. In the Australians, which I have measured, they varied in mesial length from 16 to 26 mm. in a straight line, and in greatest breadth from 6 to 13 mm., whilst the mean length was 20·5 and the mean breadth was 10·4 mm. In the Tasmanians the length varied from 13 to 19 mm., and the greatest breadth from 9 to 10 mm., the mean length was 16 mm. and the mean breadth was 9·5. In Europeans, again, as I have found in Scottish skulls, the length varied from 21 to 30 mm. and the breadth from 10 to 14 mm., whilst the mean length was 25·4 and the mean breadth 11·7 mm. The osseous part of the nose constituted in the white races a more prominent feature than in the black races. The constriction in the middle and the attenuated upper end of the apes were not seen in the human nasal bones.

Except in the gorilla, where an imperfect keel was present, the anthropoid nasals were not keeled mesially, and the nose was flattened and had no bridge. This condition also existed in the black races, in whom the profile outline of the nasal bones was concave upwards and forwards, and the curve was continuous with that of the glabellar convexity. In Europeans, again, the nasals sprang abruptly forwards and downwards from the fronto-nasal suture, and possessed the keel-like bridge which made the nose a characteristic prominent feature. Even in the infantile skulls of Europeans the nasal profile was, as development proceeded, set at an angle with the plane of the forehead.

Klaatsch in his memoir expressed the opinion that a great difference existed in the formation of the external nose in man compared with anthropoid apes, in the latter of which, he thought, the external nose corresponded with only the lower portion of the human organ. He stated that the superior borders of the anthropoid nasals were on the same plane as the internal angular processes of the frontals. Further, that the upper limit of the external nose in anthropoids corresponded with the middle of their nasals, at a point named by him *rhinion* (which apparently signified the constriction described in the above paragraphs), and not with their superior borders.

From my observations on the skulls of anthropoid apes, the nasals, in order to reach

the frontal, which they joined by a narrow articulation, definitely ascended beyond the upper ends of the ascending processes of the superior maxillæ at their articulation with the internal orbital processes. In modern man, again, the fronto-nasal suture was relatively broad and almost in the same transverse plane as the articulations of the maxillæ with the internal orbitals, though I have sometimes seen the suture a little higher in both the white and black races. So far as one can judge from casts, a similar condition existed in the Neanderthal and Spy skulls.

I have found it difficult to accept KLAATSCH's view of the morphology of the nasals; so that in measuring their length in man and the anthropoids, I have proceeded on the basis that the nasal bones belonged to the nose and that the fronto-nasal suture was its upper limit. I have also followed the same course in measuring the height of the nose, one of the two factors required for computing the nasal index.

The relation between the height of the nose, measured from the fronto-nasal suture to the base of the maxillo-nasal spine, and the greatest width of the anterior nares constitutes an important factor in craniometry. Two widely distinct types—one with a relatively long and narrow nose, called leptorhine, such as is the customary form in Europeans; the other with a relatively short and wide nose, platyrhine, such as is common in the black races—are recognised, whilst an intermediate mesorhine type is not unfrequently seen. I have examined the skulls of the anthropoid apes from this point of view and have computed a nasal index. The obliteration of the fronto-nasal suture in the adult chimpanzee and gorilla interfered with the exact determination of the height of the nose, so that with them I could obtain it only approximately, though it can be definitely stated in the young skulls. Keeping this in view, the mean nasal index in the two adult chimpanzees was 54, and in the two young specimens 48·4. In the gorilla the index in four adults was below 48, and in a fifth 50·6, and the mean was 45·1; in one of the two young specimens the index was 47·3, in the other 50. In three adult orangs the highest nasal index was 45·4, and the mean was 44·7; in one of the two young ones the index was 46·9, in the other 62·5. In one of the two gibbons in which the suture was visible the nasal index was 45, in the other 57·1.

If we employ the divisions of the nasal index which BROCA and FLOWER suggested, and which I have adopted in my series of craniometrical memoirs, the mean nasal index in the gorilla and the orangs was below 48, that is, leptorhine, whilst the mean in two adult chimpanzees was 54, that is, platyrhine. When these indices are compared with the measurements of human crania, and taking the Scottish crania which I have measured as illustrating the white races, the mean index in them was 42·5, *i.e.* leptorhine. In the Australians, again, the mean nasal index was platyrhine, and the occurrence of a nose with a leptorhine index was so rare that one was tempted to express a doubt of its authenticity. In my series of Tasmanian crania, the platyrhine character was strongly marked, a feature which prevailed in the black races generally. From this comparison it would appear that the chimpanzees in their nasal index approximated more to the black races, and the gorilla and orang more to the white

races. Owing to the imperfect facial skeleton in the remains of palæolithic man, the form and proportions of their nasal region are not definitely known.

Klaatsch also attached great importance to the boundaries of the anterior nares, and he gave an interpretation of the appearance presented by that region in the anthropoid apes when compared with the Australians. In the apes each lateral boundary was formed by a sharp ridge which ended below on the incisor surface of the præmaxillæ in a small prominence; Klaatsch named the ridge the *crista prænasalis.* Immediately posterior to it was a depression, the *fossa prænasalis*, bounded behind by a low ridge on the lateral wall of the inferior meatus, the *margo infranasalis*, which passed inwards across the nasal floor and joined the root of the rudimentary anterior (maxillo-) nasal spine, which was recessed into the floor of the nasal chamber (Pl. II. fig. 7). Klaatsch considered that all these elements could be recognised at the nares of aboriginal Australians, and illustrated the transformation of the nasal cavity of the anthropoid apes into that of the higher races of men. The variations, he said, could be traced from a sharply defined crista prænasalis to skulls in which it and the fossa prænasalis had almost disappeared, the margo infranasalis had approached the opening of the nose, and had assumed the character found in Europeans, in which the opening was bounded laterally and below by the well-defined margo infranasalis and not by the crista. Klaatsch stated that though the Sydney Tasmanian at the first glance seemed to agree with the European, it really corresponded with the Australians, and the opening was bounded by the crista prænasalis and not by the margo prænasalis. In a careful comparison of this region in the Australians and in my series of Tasmanians, I found that behind the lateral boundary of the nasal opening a fossa prænasalis and a margo infranasalis were present in each Tasmanian, though better marked in some (Pl. II. fig. 6) than in others. The anterior nares therefore had on each side, in addition to the external boundary, a descending ridge lying within the cavity and separated from the external boundary by a prænasal fossa. I also examined a number of skulls in the University Museum of Papuans, Melanesians, Polynesians, South and West African Blacks, Andaman Islanders, etc., which, whilst generally exhibiting similar characters, differed from each other in points of detail.* Usually, though not invariably, this form of anterior nares was associated with a prognathic upper jaw and with a rudimentary and recessed maxillo-nasal spine; also, as I described many years ago† in Australian skulls, the boundaries of the anterior nares, instead of being almost perpendicular, and with a sharp edge, were smooth and rounded off where they became continuous with the nasal floor, and approximated in appearance to the nares of anthropoid apes.

The prognathic character of the upper jaw was usually a strong feature in the Australians, Tasmanians and black races generally. The incisive region projected distinctly in front of the anterior nares, and was continuous with the floor of the nose,

* I must leave for a future occasion an account of the more striking variations which I have seen in different races.

† *Challenger Reports*, 1884, p. 32, Pl. II. fig. 3.

without the intervention of a margo infranasalis; the roots of the incisor teeth were directed obliquely downwards and forwards; the hard palate was frequently long and relatively narrow, and the roof of the mouth had the elongated character which I have named *dolichuranic.* The maxillary region contrasted therefore with the relatively vertical, orthognathic incisive region, the distinct margo infranasalis and the horse-shoe-shaped palate of Europeans.

Post-orbital Region.—KLAATSCH in his memoir * attached importance to the study of tracings of the horizontal outline of the cranium across the glabella in front, the inion behind, the ali-sphenoids and squamous-temporals laterally. He has reproduced a number of these tracings of Australian skulls and has compared them with Tasmanians, palæolithic man † and Pithecanthropus. I have had similar tracings made of the Tasmanian in the Brussels Museum, and of the skulls Nos. 5 and 7 in the University Museum included in my Part I. Both in the Brussels specimen and in No. 7 a deep post-orbital depression was seen, and I now reproduce (fig. 5, text) the tracing of the Brüssels skull. In No. 5 the depression was not so strongly marked; but in each skull it was associated with the concave surface of the ali-sphenoid described on page 416. I have also for purposes of comparison had tracings made of two characteristic Scottish skulls, and I reproduce the outline of one, with the tracing of the Brussels skull superimposed (fig. 5). The following Table gives the most important measurements :—

	Tasmanians.			Scottish.	
	Brussels.	No. 5.	No. 7.	B. 19.	B. 55.
Glabello-inial diameter	172	180	185	184	183
Supra-orbital breadth	95	93	101	94	99
Breadth at post-orbital depression	80	85	84	97	100
Index of post-orbital depression	*84·2*	*91·4*	*83·1*	*103·2*	*101*
Breadth at lower temporal lines	101	96	107	115	113

The temporal diameter between the curved lines was higher up than the post-orbital depression. The supra-orbital breadth in the Tasmanians taken between the temporal curved lines, some mm. above the external orbital processes, varied from 93 to 101 mm., and the mean was 96. The breadth at the deepest part of the post-orbital depression varied from 80 to 85 mm. KLAATSCH from his measurements computed an index of the post-orbital depression by the formula $\frac{\text{post-orb. dep.} \times 100}{\text{supra-orb. breadth}}$. By employing this formula I obtained an index which ranged from 83·1 to 91·4 in my three Tasmanians, with a mean 86·2. In the series of eleven Australians measured by KLAATSCH the index ranged from 74·3 to 86·6 and the mean was 80·3. He also measured the two Spy crania, the mean index of which was 83·8 and the index of Pithecanthropus was 82.

* *Op. cit.*; also in his earlier paper in *Zeitschrift für Ethnologie*, Heft 6, pp. 884–5–6, 1903.

† FRAIPONT and LOHEST (*Recherches Ethnograph. sur des Ossements humains*, Gand, 1887) figured the *norma verticalis* in the Spy and Neanderthal skulls in which the post-orbital depression is represented.

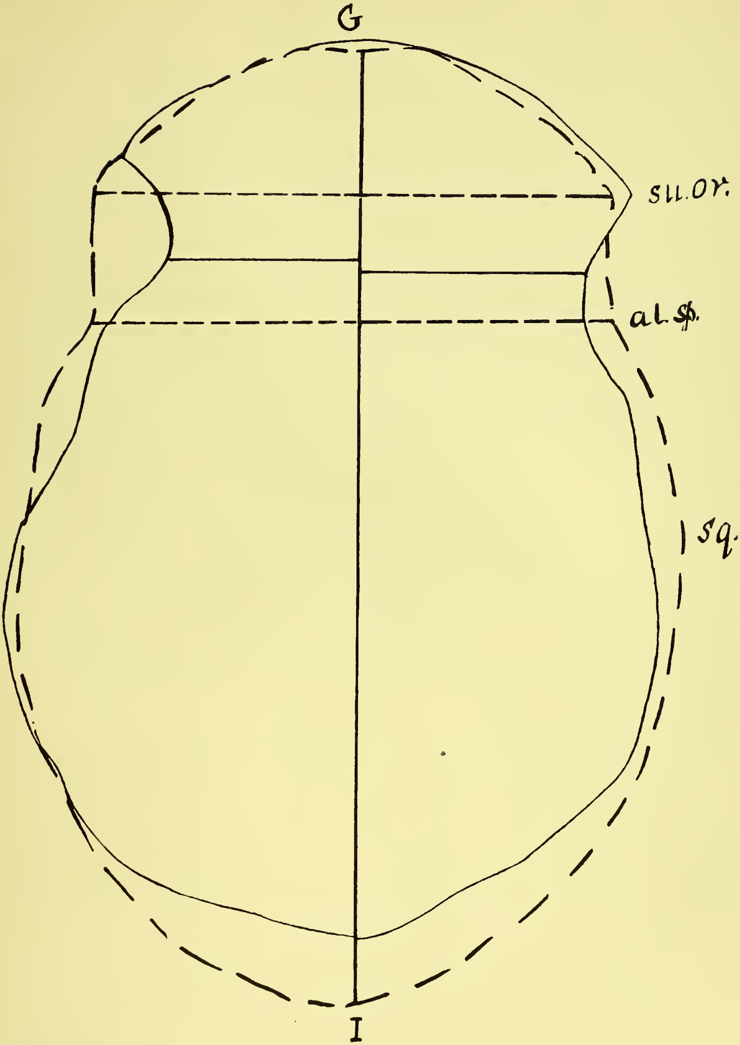

FIG. 5.—The horizontal outline of the Brussels Tasmanian is the black continuous line; that of the Scottish skull is the interrupted line.

In two Scottish skulls in the University Museum the tracings showed the breadth at the post-orbital depression to be a little more than the supra-orbital breadth, the index in each specimen was more than 100, and the mean was 102·1. In the outline drawing, fig. 5, the difference in the post-orbital depression in the Tasmanian and the Scottish skull can at once be recognised. The small number of specimens measured in each race scarcely sufficed as a basis for a wide generalisation, but as far as they go the Australian index was less than that in Pithecanthropus, in the palæolithic Spy skulls and the Tasmanians. As of these skulls the Tasmanians had the highest index, they approached nearer to the post-orbital index in the Scottish skulls, and in No. 5 the index was 91·4.

The glabello-inial diameter in each skull was not quite equal to the maximum length of the skull, which is to some extent regulated by the degree of projection of the occipital squama, associated with the growth of the occipital end of the brain.

In my descriptions of the Tasmanian skulls I have referred to their marked phœnozygous character, a condition which is produced not only by the arching of the zygoma, but by the depth of the post-orbital depression, and the tendency to flattening of the squamous temporal. The deep concavity of the outer surface of the ali-sphenoid materially contributed to the post-orbital depression, and the infra-temporal crest, which separated the temporal and zygomatic parts of this surface from each other, was scarcely to be seen in some of the crania.* The horizontal outline of the Tasmanian skull corresponded, in the post-orbital depression, with those figured by KLAATSCH from skulls in the museums in London and Paris. In the Australians the skulls were also phœnozygous, but the surface of the ali-sphenoid was not so deeply concave as in the Tasmanians. In the Scottish skulls the zygomata were not visible in the norma verticalis, *i.e.* cryptozygous, the ali-sphenoid was only slightly concave, and the transverse diameter at the temporal lines was wider than in Australians and Tasmanians.

In one of my Tasmanian skulls, No. 10, the ali-sphenoid was cut off from the parietal by a tongue-like process of the squamous which articulated with the frontal, and in three an epipteric bone, or bones, was present on one or both sides. The parieto-sphenoid articulation varied from 5 to 11 mm. in the series of skulls. In the *Challenger Report*, 1884, I reviewed the variations in the pterion in the skulls of man and apes, and referred to Australian, Papuan, Melanesian, Polynesian, European and other skulls in which I had seen the squamoso-frontal articulation and epipteric bones, though the frontal process of the squamous temporal occurred more frequently in the lower races than in Europeans. In a previous paper in which I had described skulls of the gorilla † I had pointed out that, whilst the squamoso-frontal articulation seemed to be the rule in the gorilla and chimpanzee, in the orang again the ali-sphenoid sometimes articulated directly with the parietal, at others it was separated from it by a squamoso-frontal

* KLAATSCH noticed the barely marked infra-temporal crest in the Tasmanian skull in the Sydney Museum.

† *Proc. Roy. Soc. Edin.*, vol. v. p. 344, 16th Jan. 1865. Three skulls, adult male and female and a young one, which had been collected by M. DU CHAILLU, and had been presented to the Anatomical Museum.

articulation. In the gibbons also similar variations occurred. In the old world monkeys, whilst the rule is for the squamous and frontal to articulate, in some crania this was not the case, and the ali-sphenoid joined directly the parietal. It was obvious, therefore, that both in man and apes the ossification in the pterion was subject to variation. When in man the squamoso-frontal articulation occurred, it was an individual peculiarity, and not a race character; the same should be said of the occurrence of epipteric bones.

As I have pointed out in Part I., variations in convexity occurred in the supra-inial occipital squama of the Tasmanian skulls, from a large rounded protuberance to an almost plane surface (though the inion in No. 5 formed the occipital pole), and consequently a modification in the depth of the space for the occipital lobes of the cerebrum was produced. It may suffice to state that the Brussels skull was 1 mm. less prominent than the mean of the previous series. When the occipital squama approximated to a plane surface it resembled the form of the Neanderthal skull in the occipital region, and when present in a skull it indicated, especially if the inion formed the occipital pole, a more primitive type of cranium.*

Fronto-parietal region.—The forehead, bregma and vertex are important factors in the study of the curvatures of the vault of the human cranium. The forehead ascends from the glabella and supra-orbital region, more or less vertically, and then curves backwards and upwards to the coronal suture and the bregma. In the male Tasmanians the lower forehead receded, though not to a great extent, and the frontal eminences were distinct. The upper forehead showed a mesial triangular raised area bounded on each side by a longitudinal depression. In width the forehead was narrow; the diameter at the stephanion in ten males ranged from 99 to 111 mm., and the mean was 103·6 mm.

In the Australians, whilst in females and young skulls the lower forehead receded only slightly, in adult males it definitely sloped backwards, in some specimens to a remarkable extent, and the frontal eminences projected feebly. A raised triangular mesial area was not a customary feature of the upper forehead, but frequently the line of the obliterated frontal suture was defined by a median ridge. The width of the forehead was, as a rule, greater than in the Tasmanians; in ten males the stephanic diameter ranged from 104 to 120 mm., and the mean was 108 mm. In the male Scottish skulls the lower forehead only slightly receded; the frontal eminences were fairly marked, the upper forehead had neither a raised area nor a median ridge. The forehead was broad and capacious; the stephanic diameter in ten males ranged from 116 to 130 mm., and the mean was 123·4 mm. In the Neanderthal cranium the division of the frontal into a lower and an upper forehead was faintly indicated, and the same remark applied to the frontal eminences; no median frontal ridge was present; the stephanic diameter was approximately 109 mm. Of the two Spy crania, one showed a distinct transverse demarcation between the lower and upper forehead, and the frontal eminences were in

* HUXLEY, *Man's Place in Nature*, 1863; also my paper "On the Fossil Skull Controversy" in *Quarterly Journal of Science*, April and October, 1864.

it more distinct, but in neither was the frontal mesial ridge seen; the stephanic diameter was in one approximately 97, in the other 106 mm. In Pithecanthropus the frontal sloped backwards with a continuous curve from the glabella and supra-orbital region to the coronal suture; the frontal eminences were not visible, and the bone had a median ridge; the stephanic diameter was approximately 82 mm.*

The bregma in the Tasmanians was flattened and the raised area formed a bregmatic eminence continued backwards from the frontal, whilst it was bounded on a lower plane on each side by the longitudinal depression.

In the Australians the sagittal ridge usually commenced at the bregma and passed backwards along the line of the suture; the vault sloped steeply downwards from the ridge to the temporal lines and parietal eminences, and the transverse curvature of the parietals was roof-shaped. In the Scottish skulls the sagittal ridge was absent or very faint; at and in proximity to the bregma the transverse curvature in the parietal region was rounded, so as to give requisite accommodation for the frontal and parietal lobes of the cerebrum. In the Neanderthal was a faint bregmatic eminence, but no sagittal ridge; the transverse curvature in the parietal region was rounded from side to side, and the greatest width was approximately 152 mm. The Spy crania had no definite bregmatic eminence; the sagittal ridge was indicated in one but not in the other; the vault from the sagittal suture to the parietal eminences and temporal ridges formed a gentle curve; the parietal width in one was 147 and in the other 154 mm. In Pithecanthropus the bregmatic eminence was distinct; the vault was flattened and there was no sagittal ridge; the temporal curved lines were strong; the greatest width was 130 mm.

Much attention has been paid of late years to the inclination of the frontal bone and its consequent effect on the frontal vault of the cranium, as well as to a possible change in the position of the bregma. SCHWALBE has diligently studied this question, and has come to the conclusion that the inclination of the frontal hinges upon two factors, the degree of elevation or depression of the bone, and the degree of its curvature.† SCHWALBE believed that the bregma could be displaced forwards, so that the frontal became more or less vertical. To measure the extent of this displacement he drew (*a*) a base line from the most prominent part of the glabella to the inion; (*b*) a line from the glabellar end of the base line to the most projecting part of the frontal, and he named the angle at their junction the *frontal angle*; (*c*) a line from the bregma to the glabellar end of the base line, and he named the angle at the junction of these lines the *bregma angle*. The more open the angles the more was the frontal region elevated. KLAATSCH also attached great importance to the determination of the bregma angle. In Pithecanthropus, he said, it was very low, 41°, in the Neanderthal skull 45°;

* These descriptions of the palæolithic skulls and Pithecanthropus are written from casts of the skulls in the University Museum. Owing to some of the surface markings being obscure, the measurements between these points are stated approximately.

† "Studien über *Pithecanthropus erectus*," *Zeitsch. für Morph. und Anat.*, Band 1, Heft 1, S. 1, 1899; "Der Neanderthal Schädel," *Bonner Jahrbücher*, Heft 106, 1901.

in the two Spy crania 46° and 47°. In Australians, KLAATSCH found that it varied from 51° to 62°, the mean being 57·5°. In eight Tasmanian skulls in the London and Paris museums he stated that the bregma angle varied from 54° to 59°, with the mean 57·3°. In my series of Tasmanian skulls I measured this angle in seven specimens, in which it varied from 54° to 60°, with the mean 57·1°. KLAATSCH'S series and mine, comprising fifteen skulls, closely corresponded in the range of variation, and the mean 57° may be regarded as representing the bregma angle in the Tasmanian race. KLAATSCH found that in eight Australians the bregma angle varied from 50° to 62°, with the mean 56·8°. In seventeen Australians which I measured the range was from 50° to 62°, and the mean angle was 57·1—almost identical with the Tasmanians. In six Scottish skulls the bregma angle ranged from 54° to 58°, and the mean was 56°. The variation in the mean bregma angle as between the Tasmanian, Australian and Scottish crania was only about 1°, and the Scottish skulls had the lowest mean of this series.

As I have in this and several previous memoirs, for reasons which I have elsewhere stated, taken as my base line the nasio-tentorial plane of the cranium, I have now compared in the Tasmanians the angle formed by the nasio-bregmatic chord with this base line. I found it to range from 52 to 58·5, the mean being 55·5. In seventeen Australians it ranged from 53° to 62°, with a mean 58·4°. In six Scottish from 54° to 62°, with a mean 57·1°. The Australians had the highest angle, the Tasmanians the lowest, and the Scottish were intermediate. In the measurements of the individual skulls and the mean obtained, the bregma-nasio-tentorial angle did not differ to a large extent from the bregma-glabellar-inial or bregma angle of SCHWALBE, though how far variations in these angles solved the problem of the frontal curvature is not a settled question.*

In each of these groups of skulls I took the perpendicular from the bregma-glabellar chord, and also from the bregma-nasal chord, to the most projecting part of the outer surface of the frontal. In seven Tasmanians the perpendicular of the bregma-glabellar arc ranged from 16 to 21 mm., and the mean was 18·5 mm. The bregma-nasal perpendicular ranged from 20 to 27, and the mean was 24·3 mm. In seventeen Australians the bregma-glabellar perpendicular ranged from 11 to 25 mm., and the mean was 18 mm.; the bregma-nasal perpendicular ranged from 15 to 30 mm., and the mean was 23 mm. A skull from North Queensland, in which the bregma-glabellar perpendicular was only 11 mm., contrasted in its feeble frontal curve, in

* For a criticism on the value of SCHWALBE'S bregma angle, of the elevation of the frontal bone through which its upper border moves upwards and forwards, in modern as compared with palæolithic man, and in consequence the supposed displacement forwards of the bregma and the more vertical direction of the frontal bone, I may refer to an important paper on the Australian forehead by the late Professor CUNNINGHAM in the volume of *Anthropological Essays* presented to Professor G. B. TYLOR, 1907. CUNNINGHAM objected to the value of the bregma angle, for not only is the lower end of the bregma-glabellar line subject to displacement from variations in the glabella itself, but the upper end is affected by changes in the other bones of the vault, independent of those due to elevation or depression of the frontal bone. The attempt to ascertain the position of the bregma by dropping a perpendicular to the base line and calculating the relative distance from the glabella to the point of intersection is not satisfactory, as different degrees of extension of the parietal and occipital regions, as well as differences in the growth of the frontal area, modify the position of the bregma.

which the differentiation of the lower from the upper forehead was feebly marked, with the well-arched forehead of another skull, also from Queensland, in which the corresponding diameter was 25 mm. In the six Scottish skulls the bregma-glabellar perpendicular ranged from 16 to 24, with the mean 19·8 mm.; the bregma-nasal perpendicular ranged from 24 to 29 mm., with the mean 26·6 mm.

From these measurements it will be seen that the frontal projection from the bregma-glabellar chord had in the Australians the smallest mean, 18 mm.; it was a little stronger in the Tasmanians, 18·5, and distinctly greater in the Scottish skulls, 19·8 mm. Similarly the bregma-nasal perpendicular had the smallest mean in the Australians, 23 mm.; next in dimensions in the Tasmanians, 24·3; and materially greater in the Scottish skulls, 26·6. It should be noted that where the measurements were made on skulls traced with a diagraph, they included the thickness of the bone, as well as the diameter of the cranial cavity from the inner surface of the frontal to the point on the chord from which the diameter was taken. Though the diagraph gave a faithful outline of the contour of the cranium, it did not differentiate the proportion of the perpendicular which belonged to the bone and that which appertained to the cavity. As an illustration, I may state that in one of the Australian skulls through which a section was made the perpendicular of the bregma-glabellar frontal arc was 16 mm., the thickness of the frontal at its most projection was 11 mm., which left only 5 mm. for the diameter of the cavity of the frontal arc; whilst with the same thickness of bone the perpendicular diameter of the cavity measured from the bregma-nasal chord was 13 mm. By way of contrast I would cite the corresponding dimensions in a Scottish skull, in which the bregma-glabellar perpendicular was also 16 mm., of which the frontal bone was 6 mm. thick, leaving 10 mm. for the diameter of the frontal part of the cranial cavity. The thickness of the parietal and occipital bones has also to be considered in determining the length of the perpendicular, in estimating from it the cerebral proportion of the parietal and occipital arcs on surface tracings made by the diagraph, and in comparing these tracings with mesial sagittal sections.

The determination of the position of the vertex, the highest point on the summit of the cranial vault, has long been the subject of craniographical inquiry. VON BAER measured the height from the plane of the foramen magnum to the most distant point in the median line of the summit of the skull, wherever it happened to be. This method was followed by BUSK,* the skull being held in a horizontal plane parallel with the plane of the zygomatic arches. BARNARD DAVIS also took † the base measurement from the plane of the foramen magnum. This method was for a time adopted by myself and other British craniologists, and the vertex was regarded as a little behind the bregma. Owing, however, to variations in the direction of this plane, BROCA suggested ‡ that the anterior border of the foramen magnum, or basion, a definite fixed

* See BUSK's article in the *Natural History Review*, 1862, p. 352, and pl. viii.

† *Thesaurus Craniorum*, p. xiv., 1867.

‡ *Instructions craniologiques et craniométriques*, Paris, 1885, p. 68.

point at the base, should be selected, and the diameter from it to the bregma should be regarded as the vertical diameter. Since then the basi-bregmatic diameter has been generally accepted, and was adopted in my *Challenger Reports* and subsequent memoirs. Experience has shown that in a large number of skulls this diameter may be regarded as giving the maximum height, though in some specimens this may lie a few millimetres behind the bregma.

In the description of the Tasmanian skulls in Part. I. and of the Brussels skull in the present part, I have shown that the height was less than the breadth and the vertical index was therefore less than the cephalic; the mean vertical index in the Tasmanians was 71·1 and the mean cephalic index 74·72, whilst the mean breadth-height index of the series was 95·5. In my *Challenger Report*, 1884, I analysed the relations of the height and breadth in one hundred and fifty crania of Australian aborigines, in eighty-five of which the height was more than the breadth; in fifteen they were equal; in fifty-one the height was less than the breadth, a character which was found especially in skulls from South Australia. In a series of one hundred and fifty Scottish skulls of both sexes I found that with six exceptions the breadth exceeded the height, and the cephalic index was more than the vertical.

As regards the cubic contents the Tasmanians have a small cranial cavity. In my first series the capacity of the males ranged from 1100 to 1430 in one quite exceptional skull, with a mean 1235 c.c., and in the Brussels skull the capacity was only 1080 c.c. When conjoined with the measurements of other observers the mean capacity of the skull in Tasmanian men worked out between 1200 and 1300 c.c., although a fair proportion were only about 1100. My measurements of the Australians gave 1293 as the mean capacity of twenty men, and the range in them was from 1044 to an exceptional 1514 c.c. In comparing crania which approximated to each other in maximum length the capacity of the cranial box would be influenced by the relative proportions of their dimensions in breadth and height, and in the compensating influence which an increase in one of these two diameters would exercise over a diminished diameter in the other. Thus skulls with a vault more strongly arched in a sagittal direction, but roof-shaped in the transverse arc, do not necessarily have more brain space than crania with a more flattened form of the vault, if the latter have a greater breadth. The Australians and Tasmanians, notwithstanding the differences in the relative dimensions either of breadth or height, approached each other in the mean cranial capacity. In the Scottish skulls, again, where length, breadth and height are all well marked, I obtained in seventy-three males a range from 1230 to 1855 c.c., the mean being 1478 c.c., and the lowest skull measured was only 5 c.c. less than the mean capacity of the Tasmanians.

It is difficult to state precisely the cranial capacity of Pithecanthropus, the Neanderthal and Spy crania. Schwalbe has given 1015 c.c. as the measured capacity of the skull cap, and 1230 as the estimated capacity of the Neanderthal cranium. Pithecanthropus was estimated by Dubois, its discoverer, as having a capacity of possibly 1000 c.c. It approached or was equal to the capacities of individual skulls which I

have measured of the lower types of existing men. My measurements of the cranial cavity of five adult male gorillas, the largest of the anthropoid apes, gave a range from 410 c.c. to 590 c.c., the mean being 494 c.c.* Their mean capacity therefore is less than one-half of the mean of the Tasmanians and Australians as well as much below that of palæolithic man.

The comparison of the crania of the Tasmanians with their near neighbours the aborigines of Australia, with Scottish crania as illustrating an important European type, with the remains of palæolithic man and with the anthropoid apes, leads to the following conclusions.

Europeans exhibited more closely than Australians and Tasmanians the characters of anthropoid apes in the rounded form of the orbital aperture and high orbital index; in the appearance of the nasion; in the length of the nasal bones; in the greater relative height of the nose which gave leptorhine proportions to them and to the gorilla and orang.

On the other hand Australians and Tasmanians exhibited more closely than Europeans anthropoid characters in the tendency to have the glabella, superciliary ridges and supraorbital borders massive; in the keel to the bridge of the nose being absent or imperfect; in the presence of crista and fossa prænasalis and margo infranasalis at the anterior nares; in the rudimentary maxillo-nasal spine; in the prognathic upper jaw; in the greater diameters of the crowns of the teeth; in the tendency to a mesial ridge in the cranial vault; in the smaller size of the cranial box and of its cubic capacity; in the stronger development of the torus occipitalis; in the feeble projection of the chin and of the mastoid processes.

RICHARD OWEN in his series of classical memoirs "On the Osteology of the Anthropoid Apes" † compared the characters of their skeletons with each other and with man. Whilst in some details of structure the Chimpanzee approximated to man, in other respects the Orang was more allied and in others the Gorilla; so that, amongst existing species, no ape could be regarded in all its structural characters as approaching nearer to man than any other anthropoid. There is no foundation therefore for the view that man is in direct descent from an existing species of ape.

In the general summary of the osteological characters of the human skeletons described in my *Challenger Report* ‡ I stated that from their comparative study, evidence did not exist that any one race dominated in all its characters over other races; or that any one race in all its characters was lower than other races. There did not seem to be a graded arrangement, such as would warrant the statement that the white races, which we assume to be the most highly developed, had been derived,

* "Distinctive Characters of Human Structure," *op. cit.*; also on Pithecanthropus (*Journ. Anat. and Phys.*, 1895, vol. xxix. p. 424). The capacity of the orang is about 408 c.c.; of the chimpanzee, about 421 c.c. I have measured female Australian skulls with a capacity between 930 and 998 c.c., and recently a Dravidian Bheel skull, 940 c.c.

† *Trans. Zool. Soc. London*, vols. ii.–v., 1841–1866.

‡ *Zoology*, part xlvii. p. 119, 1886.

by successive stages of gradual perfecting of structure, from the lowest or from any existing black race.

The survey to which the skulls and skeletons generally, of examples of the existing black and white races, have been subjected in this memoir and their comparison with the scanty remains of palæolithic man and with the skeletons of the anthropoid apes give strength to the opinion which I had previously expressed.

To account therefore, on the theory of descent, for the origin of man's physical structure from a pre-existing lower mammalian form, the pedigree of his body requires to be traced further back than the existing anthropoid apes. It is possible that Pithecanthropus may represent a stage in the process of evolution, and, from the dimensions of the calvaria and the apparent capacity of the brain case, it is in more direct line with existing man than with any form of ape with which we are at present acquainted.

EXPLANATION OF PLATES I., II.

The process blocks of figs. 1, 2, 3 are reproduced from photographs by Mr Ernest J. Henderson, who also traced the outline figures of the skulls reproduced in the text. Figs. 4 to 8 are reproduced from drawings of the objects made by Mr R. H. Campbell.

Plate I.

Fig. 1. Norma lateralis of the Tasmanian skull, No. 310, in the Royal Museum, Brussels.
,, 2. Fronto-parietal view of the same skull.
,, 3. Norma facialis of the same skull.
,, 4. Occipital surface of Tasmanian, No. 7, Part I., in the University Anatomical Museum. *l.supr.*, linea suprema; *in.*, inion; *scl.*, superior curved line (linea superior or torus occipitalis); *cr.*, crest; *icl.*, inferior curved line; *prm.*, processus retromastoideus.

The figures in this plate and figures 5, 6, 8 in Plate II. are reduced in size.

Plate II.

Fig. 5. Supraorbital region with torus supraorbitalis, Tasmanian, No. 6, Part I.
,, 6. Nasal region, Tasmanian, No. 1, Part I., showing crista and fossa prænasalis and margo infranasalis.
,, 7. Nasal region, young Gorilla, natural size, University Anatomical Museum.
,, 8. Upper end of left femur, Tasmanian, Brussels Museum. *x*, the extension of the articular area on the neck.

EXPLANATION OF FIGURES IN TEXT.

Fig. 1, page 413. Tracing of vertical transverse arcs, Brussels skull; *ap.* anterior parietal region at the bregmatic eminence; *mp.* mid-parietal region at the sagittal groove and the parietal eminences.

,, 2, ,, 420. Mesial sagittal contour, Tasmanian, Brussels Museum.

b. basion.	*bp.* basi-perpendicular radius.	*brgl.* bregma-glabellar line.
bal. basi-alveolar radius.	*bl.* ,, lambdal ,,	*brl.* ,, lambdal chord.
bn. ,, nasal ,,	*bin.* ,, inial ,,	*lin.* lambda-inial ,,
bg. ,, glabellar ,,	*nt.* nasio-tentorial plane.	*gl. in.* glabello-inian line.
bbr. ,, bregmatic ,,	*brn.* ,, bregma-nasal chord.	

Fig. 3, page 431. Upper end of right tibia, skeleton Brussels Museum, *x* attachment of ilio-tibial band.

,, 4, ,, 431. Tracing of external condylar surface of same tibia; *a.* anterior, *p.* posterior end.

,, 5, ,, 445. Horizontal tracing of outline of the Brussels Tasmanian skull and of a Scottish skull around the glabello-inian plane; the broken line is the outline of the Scottish skull, the continuous black line that of the Tasmanian; *G.I.* the glabello-inian line; *su. or.* supraorbital breadth; *al. sp.* great wing of sphenoid; *sq.* squamous-temporal.

Fig. 1.—Tasmanian, Brussels Museum.

Fig. 2.—Tasmanian, Brussels.

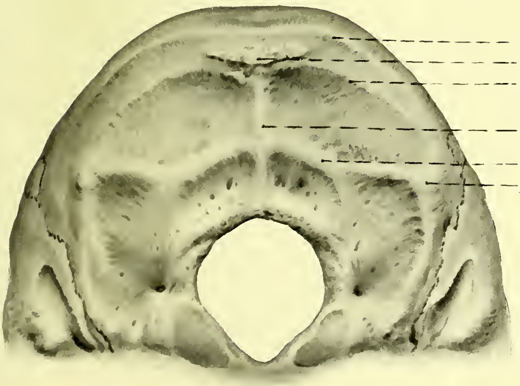

Fig. 4.—Occipital Surface of No. 7, Part I.

Fig. 3.—Tasmanian, Brussels.

Sir William Turner: "The Tasmanian Skeleton," Part II., Plate II.

Fig. 6.—Tasmanian, No. 1, Part I.

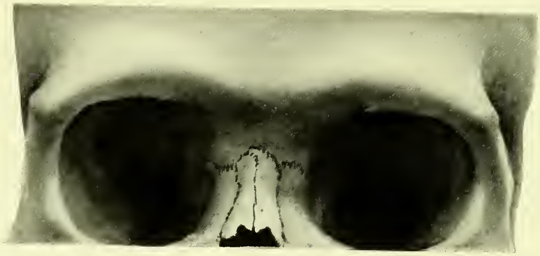

Fig. 5.—Tasmanian, No. 6, Part I.

Fig. 8.—Tasmanian, left femur.

Fig. 7.—Gorilla, juv.

The TRANSACTIONS of the ROYAL SOCIETY OF EDINBURGH will in future be Sold at the following reduced Prices:—

Vol.	Price to the Public.	Price to Fellows.	Vol.	Price to the Public.	Price to Fellows.
VI.	£0 11 6	£0 9 6	XXXIX. Part 1.	£1 10 0	£1 3 0
VII.	0 18 0	0 15 0	,, Part 2.	0 19 0	0 14 6
VIII.	0 17 0	0 14 0	,, Part 3.	2 3 0	1 11 0
IX.	1 0 0	0 17 0	,, Part 4.	0 9 0	0 7 0
X.	0 19 0	0 16 0	XL. Part 1.	1 5 0	0 19 0
XI.	0 14 6	0 12 0	,, Part 2.	1 12 6	1 5 6
XII.	0 14 6	0 12 0	,, Part 3.	1 6 0	0 19 6
XIII.	0 18 0	0 15 0	,, Part 4.	1 0 0	0 16 0
XIV.	1 5 0	1 1 0	XLI. Part 1.	1 1 0	0 15 9
XV.	1 11 0	1 6 0	,, Part 2.	1 9 6	1 2 0
XX. Part 1.	0 18 0	0 14 0	,, Part 3.	2 5 0	1 13 6
XXII. Part 2.	0 10 0	0 7 6	XLII.	2 2 0	1 11 0
,, Part 3.	1 5 0	1 1 0	XLIII.	2 2 0	1 11 0
XXVII. Part 1.	0 16 0	0 12 0	XLIV.	*Not yet*	*published.*
,, Part 2.	0 6 0	0 4 6	XLV. Part 1.	1 9 0	1 2 0
,, Part 4.	1 0 0	0 16 0	,, Part 2.	1 7 0	1 0 0
XXVIII. Part 1.	1 5 0	1 1 0	,, Part 3.	1 13 9	1 5 3
,, Part 2.	1 5 0	1 1 0	,, Part 4.	0 4 6	0 3 6
,, Part 3.	0 18 0	0 13 6	XLVI. Part 1.	1 1 10	0 16 6
XXIX. Part 1.	1 12 0	1 6 0			
,, Part 2.	0 16 0	0 12 0			
XXX. Part 1.	1 12 0	1 6 0			
,, Part 2.	0 16 0	0 12 0			
,, Part 3.	0 5 0	0 4 0			
,, Part 4.	0 7 6	0 5 8			
XXXI.	4 4 0	3 3 0			
XXXII. Part 1.	1 0 0	0 16 0			
,, Part 2.	0 18 0	0 13 6			
,, Part 3.	2 10 0	1 17 6			
,, Part 4.	0 5 0	0 4 0			
XXXIII. Part 1.	1 1 0	0 16 0			
,, Part 2.	2 2 0	1 11 0			
,, Part 3.	0 12 0	0 9 6			
XXXIV.	2 2 0	1 11 0			
XXXV.*Part 1.	2 2 0	1 11 0			
,, Part 2.	1 11 0	1 3 6			
,, Part 3.	2 2 0	1 11 0			
,, Part 4.	1 1 0	0 16 0			
XXXVI. Part 1.	1 1 0	0 16 0			
,, Part 2.	1 16 6	1 7 6			
,, Part 3.	1 0 0	0 16 0			
XXXVII. Part 1.	1 14 6	1 5 6			
,, Part 2.	1 1 0	0 16 0			
,, Part 3.	0 16 0	0 12 0			
,, Part 4.	0 7 6	0 5 8			
XXXVIII. Part 1.	2 0 0	1 10 0			
,, Part 2.	1 5 0	0 19 0			
,, Part 3.	1 10 0	1 3 0			
,, Part 4.	0 7 6	0 5 8			

* Vol. XXXV., and those which follow, may be had in Numbers, each Number containing a complete Paper.

January 1908.—Volumes or parts of volumes not mentioned in the above list are not for the present on sale to the public. Fellows or others who may specially desire to obtain them must apply direct to the Society. As the Society reprints from time to time parts of its publications which have become scarce, the absolute correctness of this list cannot be guaranteed beyond this date.

TRANSACTIONS

OF THE

ROYAL SOCIETY OF EDINBURGH.

VOLUME XLVI. PART II.

[*For Prices of previous Volumes and Parts see page* 3 *of Cover.*]

PRINTED BY NEILL AND CO., LTD., EDINBURGH.